

**Strengthening care
for the injured:**

**Success stories and
lessons learned
from around the
world**

WHO Library Cataloguing-in-Publication Data

Strengthening care for the injured: success stories and lessons learned from around the world

1.Wounds and injuries - therapy. 2.Delivery of health care. 3.Emergency medical services - organization and administration. 4.Rehabilitation.
I.World Health Organization. Dept. of Violence and Injury Prevention and Disability.

ISBN 978 92 4 156396 3

(NLM classification: WO 700)

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Preface

Injury accounts for a significant proportion of the world's burden of disease. Each year 5.8 million people die from injury and millions more are disabled. The response to this global health problem needs to include a range of activities, from better surveillance to more in-depth research, and primary prevention. Also needed are efforts to strengthen care of the injured. The World Health Organization (WHO) has responded to this need with a variety of actions. It has supported countries in setting up trauma care programmes and in developing their capacity to care for the injured. It has also developed, in consultation with global experts, guidelines to assist with the organization and planning of trauma care, such as *Prehospital trauma care systems*, *Guidelines for essential trauma care*, and *Guidelines for trauma quality improvement programmes*. These publications have been used in many countries and have helped to stimulate 'on the ground' improvements and policy changes.

Efforts to improve care of the injured globally received a major boost in 2007 when the World Health Assembly (WHA) adopted resolution WHA60.22 on trauma and emergency care services. This called upon governments and WHO to increase their efforts to improve care for victims of injury and other medical emergencies. It also called upon WHO to raise awareness about affordable ways in which trauma and emergency care services can be strengthened, especially through universally applicable means such as improvements in organization and planning. Similarly, resolution WHA58.23 on disability, including prevention, management, and rehabilitation, requested WHO to provide support to countries in developing rehabilitation services for people with disabilities.

In response to these requests WHO collected this set of case studies, documenting success stories and lessons learned from several countries. Through this publication, WHO seeks to increase communication and the exchange of ideas among those working in the field of trauma care, whether in the prehospital setting, in acute care in hospitals, or in longer term rehabilitation; to increase communication among those involved in planning, administering, advocating for, or directly providing trauma care services; and to increase communication among those working in the field of trauma care in different countries worldwide.

This publication contains only some of the innovative and significant work being done by many individuals, institutions, and governments globally. We have provided a range of case studies, including those from prehospital, hospital-based, rehabilitation, and system-wide settings, and from countries in all regions of the world and at all socioeconomic levels. These case studies have common themes and lessons learned. One of the most important of these is the need for perseverance, as many of the improvements took years to implement. Another lesson is the need for attention to detail. There was no magic bullet involved. Improvements occurred primarily by attention to detail in planning and organization. There are also important lessons learned about the role of health policy in extending trauma care improvements nationwide, beyond centres of excellence, and about the importance of using advocacy to increase political commitment, whether at the national, provincial or institutional level. Finally, the case studies show that improvements can be made even in the poorest and most difficult of circumstances, and that even well-resourced environments can benefit from improved organization and monitoring of trauma care services.

On behalf of the many people who have contributed to this publication, I call upon all of those working in the field of trauma care, and all who would like to see improvements in care of the injured, to make use of the lessons learned from the noteworthy examples in this publication.

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Acknowledgements

The World Health Organization and the editorial committee acknowledge with thanks the reviewers and contributors whose dedication, support and expertise made this publication possible.

This publication also benefited from the contributions of a number of other people. In particular, acknowledgement is made to Angela Burton for editorial assistance; Irene Lengui for design of the cover and layout; and Pascale Lanvers-Casasola, Claire Scheurer and H el ene Dufays for administrative support. Acknowledgement is also made to the many colleagues from World Health Organization Regional Offices and Country Offices who facilitated the collection of information for the case studies in this publication.

The World Health Organization and the editorial committee also wish to thank the following for providing funding for the development, writing and publication of this document: the United States Centers for Disease Control and Prevention, and the World Bank Global Road Safety Facility.

Executive summary

The response to the global problem of injury needs to include strengthening care of the injured (i.e. trauma care). There are many excellent examples of improvements in care of the injured in different countries worldwide, and at all economic levels. Those who care for the injured, or who plan, administer, or advocate for trauma care services, can learn much from each others' efforts.

The goal of this publication is to share some of the valuable lessons learned by those working on different but overlapping aspects of trauma care worldwide. It focuses on practical, affordable and sustainable efforts, identifying useful methods and strategies that could be adapted for use in other places. This publication also seeks to dispel the view that little can be done to improve trauma care, especially in low- and middle-income countries.

Each case study follows a similar structure – a statement of the problem, a description of interventions made and the results of these interventions. Practical aspects are emphasized, so that people working in other similar environments can adapt the methods. We examine the results by looking at one or more of the following: **structure, process, outcome**.

Outcomes data on decreased mortality or other tangible patient benefits, such as decreased morbidity, improved functional outcome or decreased costs are presented where available. Where not available, important lessons can still be learned from the results of improvements in the **process** or **structure** of care. These include measures such as decreased time to emergency procedures or increased appropriate use of particular life-saving procedures (**process**). They also include more ready availability of the human and physical resources needed to provide quality care, or improved administrative ability to monitor and supervise such care (**structure**).

Included are case studies from across the spectrum of prehospital care, acute hospital care, longer term rehabilitation both in the health-care setting and the community, and system-wide improvements.

1. Prehospital care

In post-conflict, landmine-ridden rural areas of Cambodia and Iraq, there were no formal emergency medical services (EMS). An innovative programme created a two-tier network of village 'first responders' (villagers who had completed a 2-day basic first aid course) and paramedics (trained on a 450-hour course). Mortality among injured people declined dramatically, from 40% to 9%. This programme supplied training and basic equipment, but no ambulances or other vehicles. Over time, the system grew and adapted to a changing epidemiological pattern, caring for increasing numbers of road traffic crash victims and other medical emergencies.

In Ghana, a large number of injured people die in the field (i.e. in the prehospital setting), without any possibility of accessing medical care. In response, the government created the National Ambulance Service. This was created with a well-organized structure of administration, clearly defined standards for staff training and for equipment carried in ambulances, well-defined operating procedures, accurate recording of data of cases handled, and use of that data for management and quality improvement. Since its inception, use of the service has grown steadily and key performance indicators, such as response time and scene (case handling) time, have consistently improved.

In an already established, basic prehospital EMS in Mexico, several affordable and sustainable improvements in infrastructure and training were made. These included wider distribution of satellite ambulance stations and use of in-service training courses for paramedics. This resulted in decreased prehospital times, increased use of appropriate manoeuvres for spinal immobilization and airway maintenance, and decreased mortality.

In both Colombia and Romania, nationwide legislation on EMS was enacted. This established more uniform and nationwide standards for training levels for prehospital EMS staff, for equipment in ambulances, and for operating procedures for ambulance systems. Mechanisms were put in place to allow government to enforce these standards. Development of the legislation involved close collaboration between government and EMS professionals.

2. Hospital-based care

In Thailand, a quality improvement programme was instituted at one of the main hospitals. The hospital administration set up a trauma audit committee and gave it the power to make changes. It used a trauma registry to identify correctable problems, including insufficient resuscitation of patients in shock and prolonged time to reach emergency head surgery. Corrective action included increasing senior staffing levels in the emergency department at peak times, and a radio system in the hospital to better alert neurosurgeons and other specialists when they were needed. Preventable deaths and overall trauma mortality decreased.

At the main hospital in Qatar, care of the injured was better organized by creating a formal trauma service. This consisted of trauma teams with designated leaders and multidisciplinary members (including doctors of several specialities, nurses, pharmacists and social workers), who worked together to provide comprehensive care to the injured. There was also better monitoring of care with a well-developed quality improvement programme. These improvements resulted in better quality of care, such as decreased times to emergency surgery, and improved resource utilization, such as decreased length of stay.

In Viet Nam, an assessment was made of trauma care capabilities in the network of clinics and hospitals in the capital, Hanoi, and surrounding rural areas. This demonstrated several opportunities for improvement, many in low-cost resources. Training programmes were instituted, as was greater attention to detail in the stocking and procuring of equipment and supplies for trauma care. There had been considerable improvement in trauma care capabilities when the assessment was completed the following year, despite no extra budget being allocated to trauma care.

3. Rehabilitation

In Brazil, rehabilitation services were unable to keep up with the growing number of people severely disabled by road traffic crashes and other types of injury. An innovative rehabilitation team was created at a busy acute care hospital. This provided consultation for patients with severe injuries soon after admission, and a rapid start on rehabilitation work (including training family members). No longer were there delays in rehabilitation while waiting for a place in a separate rehabilitation facility. Complications such as pressure sores, urinary tract infections and joint deformities declined dramatically.

The earthquake in Gujarat, India, left a large number of people with paraplegia, for whom existing rehabilitation services were minimal. A programme developed by the state health services, non-governmental organizations and civil society led to better availability of rehabilitation services (including expertise, affordable wheelchairs and other assistive devices) in hospitals, clinics, and in the community. Five-year mortality among paraplegic people declined from 60% to 4%. The programme was scaled-up across the entire state and grew to include a wide range of disabilities.

4. System-wide improvements

Trauma mortality rates in Quebec Province, Canada, were higher than many other places in North America. This was felt to be the result of disjointed and non-standardized care by the many different ambulance services and hospitals. Province-wide improvements included creating guidelines for prehospital triage, care at the scene (to decrease prehospital times) and inter-hospital transfer. Criteria were established for

trauma care capabilities at hospitals of varying levels and enforced through an external review board. A statewide trauma registry provided data to monitor these changes and confirmed that mortality rates among the severely injured decreased from 52% prior to initiation of the system in 1990 to 8% from 1998 onward.

The Trauma Secretariat in Sri Lanka is a government initiative involving many of the key groups and individuals involved with trauma care. It seeks to comprehensively address all parts of the trauma system in nationwide planning, and through on-the-ground work. It has reviewed EMS legislation and advised government on necessary changes; developed clinical protocols; coordinated training for several types of trauma care staff; supported EMS development in individual communities; and established a nationwide trauma registry. Although in existence for only 3 years, it has put in place many of the same elements that were created in the Canada case study, but adapted for a Sri Lankan environment.

This publication ends with a summary of lessons learned from all of the case studies. These are grouped into three broad categories: overarching issues, tools to use in promoting improvements, and policy and advocacy. Among the overarching issues is the need for perseverance, as most of the improvements reported took years, sometimes a decade or more, to implement. Another overarching issue is the need for attention to detail. There was no magic bullet involved in any of these improvements. They occurred through painstaking attention to detail in planning and execution. Almost all of the case studies demonstrate the importance of better organization and planning. A final important overarching issue is that improvements can be made even in the poorest and most difficult of circumstances, and that even well-resourced environments can benefit from improved organization and monitoring of trauma care services.

Among tools to use in promoting improvements, training was an important component in many of the case studies. This was most effective when reinforced by supervision and monitoring. Another important lesson learned was the importance of emphasizing the basics. Most of the case studies reported progress primarily through ensuring widespread availability of basic services, rather than by focusing on costly technology. There is also the need for timely and accurate data to better inform policy options, and to assess whether or not interventions have had their intended results.

Among policy and advocacy issues, an important lesson learned is the key role of political commitment, whether at national, provincial or institutional levels. Likewise, policy changes are an important avenue for promoting widespread improvements beyond centres of excellence. Political commitment can be garnered and policy changes promoted by advocacy, which is a fundamental necessity in efforts to promote longer term and broad trauma care improvements. Such advocacy and associated trauma care improvements can be accomplished through leadership, especially by those working on the ground. Many accomplishments in the case studies resulted from clinicians leading efforts to improve the scenario in which they worked. Such leadership is more effectively applied when it is extended with partnerships, including partnerships with government, non-governmental organizations, civil society and the community.

In summary, this publication seeks to highlight the significant progress being made in strengthening care of the injured, in countries at all economic levels and across the spectrum of prehospital, acute hospital care, rehabilitation, and system-wide. We hope that this publication fosters greater collaboration and exchange of ideas among those working in the field, and leads to more widespread and systematic efforts to strengthen trauma care services in all countries. In so doing, the lives of many injured people will be saved, many injury-related disabilities averted, and people with disabilities will receive better services and be integrated back into active life more fully.

Introduction

Injury¹ is leading cause of death and disability worldwide. Trauma care (care of injured people) is an important component of the response to the injury problem. A significant proportion of the deaths and disabilities caused by injuries could be eliminated by improvements in trauma care, but there is often a sense that such improvements are too difficult, complicated or expensive to institute widely, especially in low- and middle-income countries. However, considerable progress has been made in many places, often with very limited resources and under very difficult circumstances. The goal of this publication is to highlight these local success stories and dispel the view that little can be done to improve trauma care globally. This publication also seeks to foster greater collaboration and exchange of ideas among those working in the field.

In World Health Assembly (WHA) resolution WHA60.22, the World Health Assembly requested WHO to help Member States strengthen their trauma and emergency care services. This included action “to raise awareness that low-cost ways exist to reduce mortality through improved organization and planning of provision of trauma and emergency care”. Likewise, resolution WHA58.23 on disability, including prevention, management and rehabilitation, requested WHO to support countries in developing rehabilitation services for people with disabilities. This publication is intended to meet these requests.

The case studies that follow focus on practical, affordable and sustainable methods, identifying useful strategies that could be adapted for use in other places. They were selected on the basis of available literature and the knowledge of the WHO’s Trauma and Emergency Care Services (TECS) advisory group about interesting, on-the-ground work as yet unpublished. All WHO regions are represented, as are all income levels (low, middle and high). Topics covered include prehospital care, acute hospital-based care, long-term rehabilitation of injured survivors (both in hospital and in the community), and implementation of health policy and province-wide/nationwide trauma care systems. The cases selected are meant to be representative, but not all-encompassing, and a great many suitable case studies have been left out because we do not have space for them all.

Each case study follows a similar structure.

1. **Introducing and defining the problem:** includes an explanation of the trauma care scenario upon which the new programme or change was built.
2. **Explaining the improvements made:** what did stakeholders do to address the problem? Practical aspects are emphasized, so that people working in similar environments can adapt the methods.
3. **Assessing the results of the improvements:** looking at one or more of *structure, process, outcome*. For example, outcomes data on decreased mortality or other outcomes of tangible patient benefit (such as decreased morbidity, improved functional outcome, or decreased costs) are presented where available. However, quantitative measures such as these are more likely to be available for well-funded projects or in environments with good data sources. There is less ability to undertake such quantitative measures for actions (e.g. nationwide policy changes) that take years to implement, or for locations where data sources are not well developed. However, important work is being done in such locations and needs to be highlighted. When quantitative outcome measures of mortality and morbidity are not available, case studies highlight improvements in the process of care or the structure available to provide such care.
 - The process of care implies measures such as decreased time to emergency procedures or increased appropriate use of life-saving procedures.

¹ The terms ‘injury’ and ‘trauma’ are used interchangeably throughout this publication.

- The structure of care includes the ready availability of the human and physical resources needed to provide quality care, or improved administrative ability to monitor and supervise such care. In these circumstances, the emphasis is on how such improved structure can be accomplished sustainably and affordably. In many low-income countries, improving the structure of care sustainably (e.g. having adequately trained staff and necessary equipment consistently available when previously they were not) is a significant achievement and provides important lessons learned for others working in similar circumstances.

Many of the solutions described in each case study are specific to the problems and circumstances in that given location (e.g. geography, health-care structure, culture, socioeconomic level) and should not necessarily be applied wholesale in other locations. Rather, the major lessons to be learned from each case study relate to better understanding local problems, developing evidence-based interventions to address them, and sustainably enacting tailored interventions, which often require improvements in organizing and planning. Another critical part of the process is evaluating whether interventions have been effective or not, and therefore whether or not they are to be continued.

The individual case studies are written scientifically and are intended to be useful for those in the field, especially those who wish to replicate some of the work in their own location. However, the case studies are not so technical that they cannot appeal to a wide range of constituents. The target audience for this publication includes policy-makers, ministry of health officials, academics, health workers, non-governmental organizations, the media and members of the public. This publication is intended for anyone who wishes to advocate for affordable and sustainable improvements in trauma care.

1. Prehospital care

Cambodia and Iraq: Improving rural prehospital care in the absence of formal emergency medical services

1. Introduction and statement of problem

The two areas in this case study are very different: northern Iraq (Sulaymaniyah Governorate) and northwest Cambodia (Battambang Province). But despite different geographic locations and features, these regions share a tragic history of prolonged conflict. As a result of these conflicts, both areas had some of the most extensive minefields in the world: the Cambodia-Thailand border and the Iraq-Iran border. These minefields were unmapped and even when dangers were known, local farmers and their children had to go repeatedly into landmine areas to herd their flocks to pasture, gather firewood and farm. As a result, landmine-related injuries were common.

Both locations for this case study were rural areas experiencing high incidences of landmine injuries. Evacuation times for the injured were long. Telecommunications and roads were poor, there were no formal emergency medical services (e.g. ambulance system) and limited local capabilities for first aid. Evacuation of the wounded was done primarily using donkeys and hammocks carried by other villagers from the site of the injury, and then by private or commercial vehicle from village to area hospitals. There was usually no prehospital first aid given. In 1996, one study from these areas showed an estimated mortality rate among mine casualties of 40% – a figure that closely reflects those in studies from other rural minefields.

Furthermore, the economic, health care, and educational infrastructure of both areas had been severely damaged by years of conflict and the traditional culture had been fragmented as many villagers had been displaced. Financial resources for dealing with the problem of high numbers of severely injured people in remote locations were very limited. For those involved with trauma care in other parts of the world, it is hard to imagine more difficult circumstances in which to work, or a more difficult scenario to try to improve.

2. Improvements implemented

Efforts to improve the care of mine blast and other severely injured people in these rural areas were based on the concept of the 'Village University'. This involved training local communities in prehospital life-support methods and delegating life-saving skills to non-doctors. The training emphasized that most avoidable trauma deaths occur outside the hospital, and that efficient prehospital life support is therefore a question of doing basic and simple things as soon as possible, and as close as possible to where the injury happened.

In each of two project areas (northern Iraq and northwest Cambodia), local health departments and local citizens collaborated with outside trainers. In each area 22 local health workers were selected for training. Two of these were doctors, who subsequently became local coordinators for the project. The rest were non-doctor health workers with little or no formal medical training, some already working in

local primary health-care networks. All trainees were recommended by their village leaders and other community members because of their extensive hands-on trauma experience gained in local conflicts, and because of their high standing in the community. In these areas with hardly any health services, paramedics were selected geographically to create a chain of survival from the minefield to the surgical hospital in the city.

The Village University training model drew on trainers' experience of the Afghan-Soviet conflict of the 1980s and 1990s, focusing on simple prehospital techniques, especially keeping airways open and stopping bleeding. This model comprises three modules, going from basic to advanced life-support interventions. Having successfully completed the first module, each trainee got one Burma Pack – a 25 kg back-pack medical kit with emergency medical equipment for three severely injured patients. Between each module the trainees treated and evacuated mine casualties, systematically registering physiological risk indicators and trauma mortality. A summary of the training programme is provided in Box 1.

The core group of 44 paramedics was trained between 1997 and 1999. The most experienced were appointed as instructors for new training courses. New paramedics then joined the programme, trained entirely by local instructors. By 2001, a total of 135 paramedics had been trained.

Box 1 Summary of paramedic training in Cambodia and Iraq

STEP 1 (1997): 44 TRAINEES, 150 HOURS

- ⊕ Airway (buddy training): Basic manoeuvres, positioning
- ⊕ Breathing (buddy and mannequin training): Positioning, cardiopulmonary resuscitation (CPR), ketamine pain-relief
- ⊕ Circulation (anaesthetized extremity injured animals): Subfascial packs and compression (including long compressive dressings, but not tourniquets), hypothermia prevention, hypotensive fluid resuscitation
- ⊕ Medical documentation: physiological risk indicators
- ⊕ Burma Pack provided
- ⊕ Exam and certification

6 months' practice:

Treat and document trauma victims
Train at least 50 village first helpers each

STEP 2: 44 TRAINEES, 150 HOURS

Evaluation of previous treatment and teaching

Rehearsal of Step 1

- ⊕ Airway (mannequin training): endotracheal intubation
- ⊕ Breathing (anaesthetized injured animals): naso-gastric and chest tube placement
- ⊕ Circulation (anaesthetized injured animals): bleeding control in multi-trauma
- ⊕ Exam and certification

6 months' practice:

Treat and document trauma victims
Train at least 50 village first helpers each

STEP 3: 44 TRAINEES, 150 HOURS

Evaluation of previous treatment and teaching

Rehearsal of Steps 1 and 2

- ⊕ Airway (anaesthetized injured animals): surgical airway
- ⊕ Circulation (anaesthetized injured animals): damage-control laparotomy
- ⊕ Exam and certification

Practice:

Treat and document trauma victims
Train at least 100 village first helpers
each per year

End-point (2001)

Analysis of results of programme

An integral part of the programme was expanding the network of care to include a large, widely spread 'first tier' of first responders in villages to reduce response times. To do this, paramedics recruited volunteers in villages and conducted 2-day training sessions on basic first aid. These were followed by 1-day rehearsal refresher trainings 6–12 months later. The village first responders included men, women and children. Each paramedic trained at least 50 first responders between each stage of their own training. At the end of the 5-year intervention, 5,200 first responders had been trained in the villages. An additional, explicit aim of the training programme was to rebuild trust and repair broken social networks in these remote, rural areas.

There was also a system of close mentoring of the paramedic trainees and monitoring of the care they provided. This was provided by a coordinator with extensive hands-on experience in trauma care who conducted monthly rehearsal-training sessions for the paramedics, as well as providing feedback on questions raised by the cases they managed. In Iraq this was a local doctor and in Cambodia a senior paramedic.

The programme did not provide ambulances or other vehicles. Injured persons continued to be taken to area hospitals by relatives, other villagers, and, after institution of the programme, by village first responders and paramedics using whatever form of transport was available. Light cases were managed by district hospitals or village health centres. Major cases were evacuated to surgical centers. In both areas there was one surgical referral hospital, run by the Italian relief organization, Emergency.

In addition, a record-keeping system was put in place to help monitor and evaluate the programme. For each case they managed, the paramedics recorded information which was then collected by local coordinators. This included diagnosis, physiological severity at first contact in-field and on hospital admission, and prehospital treatment given. Physiological severity was assessed by blood pressure, respiratory rate and level of consciousness. Data recorded by the paramedics were supplemented by hospital data for those cases taken to the surgical referral hospitals. This evaluation system allowed detailed monitoring of the effectiveness of the overall programme, as discussed below.

3. Results

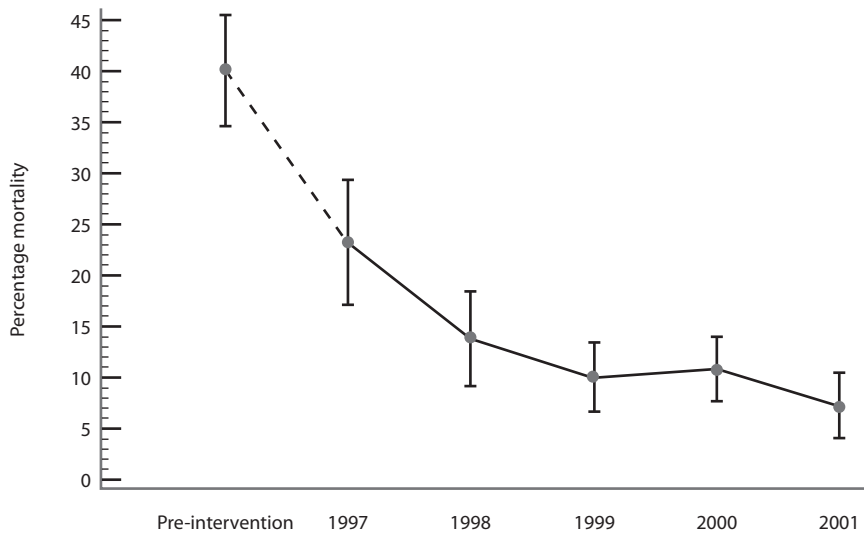
At the end of the first 5 years, an in-depth assessment was conducted. A total of 1061 trauma victims had been managed, most of them with severe injuries (mean Injury Severity Score¹ of 12). The mean response time from injury to first medical contact was reduced from 2.9 hours in 1997 to 1.8 hours in 2001. Given the remote areas in which the work was conducted, the mean prehospital transit time did not change and remained 5.7 hours.

Most patients had only basic first aid or basic life-support measures carried out. For example, among the 221 patients with severe limb injuries and shock (systolic blood pressure below 90), gauze packing of wound tracks or amputation wounds, compressive dressings and proximal artery compression were used to control bleeding. Patients with shock were resuscitated with IV crystalloid (mean of 3 litres) and hypothermia prevention. Among the overall group of 1061 trauma victims, very few were given any advanced life-support manoeuvres: just five patients had endotracheal intubation or cricothyrotomy done in-field, and four patients had chest tubes placed in-field by paramedics.

There was a considerable reduction of trauma mortality – the pre-intervention level stood at 40% and it fell to around 8% during the final stage of the study period (see Figure 1). The intervention corroborated Village University experience on the battlefields of Afghanistan – that lives are saved by simple things being done early.

¹ Injury Severity Score is a coding system that gives a numeric score corresponding to the overall severity of bodily injury. This score closely correlates with mortality and ranges from 1 (minimal injury) to 75 (catastrophic, uniformly fatal injury).

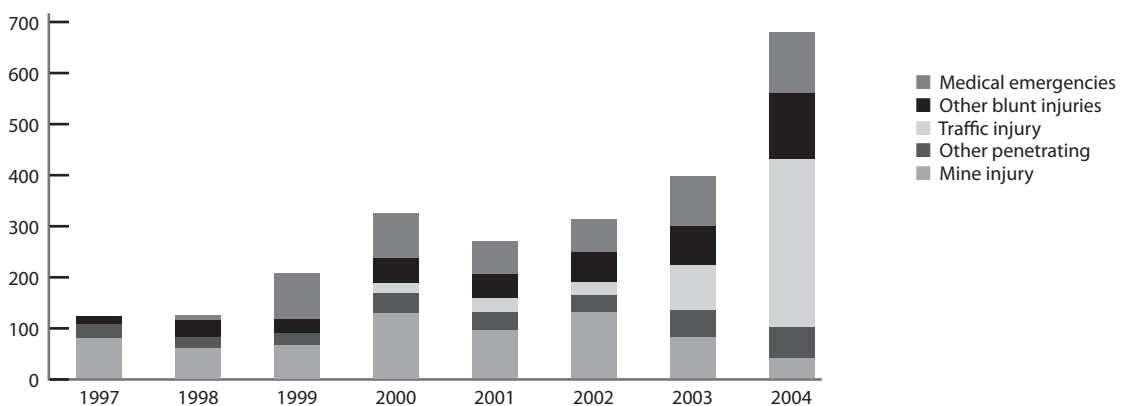
Figure 1 Mortality among injured people cared for by the Village University trauma system in Cambodia and Iraq



Results are expressed as yearly means, with 95% confidence interval bars (a measure of statistical accuracy). Source: Hans Husum (with permission).

Moreover, the systems established by the Village University programme proved adaptable and expandable as local situations evolved. In Cambodia the training programme has grown to include district hospitals. In Iraq, the epidemiological scenario has changed, with falling rates of landmine injuries and rising rates of road traffic injuries. The proportion of mine and penetrating injuries managed by the prehospital trauma system decreased from 91% in 1997 to 15% in 2004. The system has adapted accordingly, handling a wider variety of injuries as well as other medical problems, in response to the requests of the local community. The paramedic and first responder training programmes were also adjusted. By training more prehospital care staff, more victims received treatment, as shown in Figure 2. For these people, the mean time from injury to first medical help (whether by first responder or paramedic) fell from 2.4 hours in 1997 to 0.6 hours in 2004.

Figure 2 Number and type of emergencies receiving prehospital care from paramedics in the programme area in northern Iraq



Source: Wisborg et al. Prehospital trauma system in a low-income country: system maturation and adaptation during eight years. *Journal of Trauma*, 2008, 64:1342-8 (with permission)

In summary, this case study shows that significant improvements in trauma care can be made in the prehospital setting, even in under-resourced, low-income environments. These improvements did not rely on setting up formal emergency medical services with ambulances, but rather on increasing the capacity of the existing primary health-care network. Likewise, the improvements emphasized early provision of basic care, with only rare use of advanced life-support interventions. Finally, the foundation of these improvements was local control and adaptability as the situation on the ground changed.

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Ghana: Birth and growth of the National Ambulance Service

1. Introduction and statement of problem

Road traffic crashes and other forms of injury pose a growing health problem in Ghana. There have been efforts to improve the capabilities of hospitals to respond and reduce overall injury mortality rates, but these efforts have been limited by the simple fact that the majority of injury deaths occur away from health facilities. One study showed that more than 80% of injury deaths occur in the prehospital setting, even in urban environments. The preponderance of deaths in the prehospital setting is likely to be even higher in rural areas.

Addressing such a situation is not straightforward. Until the early 2000s, prehospital trauma care in Ghana was informal and extremely limited. Most severely ill or injured people who reached a health facility were brought there by commercial vehicle (e.g. taxi or minibus). In some cases this involved relatives paying commercial drivers for their services. In some cases it involved drivers acting as 'good samaritans', transporting injured people from crash scenes they had come across in the course of their driving work. At times this service included some first aid, usually carried out without any formal training. Moreover, even the capabilities for transfer between hospitals and clinics were limited, as most hospitals did not have their own ambulances. When a smaller facility could not handle a severe case, transfer to a higher level facility typically involved a taxi, which the relatives had to arrange and pay for themselves. As this was often very expensive, relatives needed time to get the necessary funds, and delays of several days for transfer of severely ill or injured patients were common.

There had been some attempts at addressing these problems, such as providing first aid training to commercial drivers who had become the *de facto* prehospital care system. However, no organized activities for this had been developed. Likewise, attempts had been made over the years by various health administrations and political leaders to set up ambulance systems in several cities. However, these efforts often amounted to giving ambulances to hospitals with no planning for the training of staff who would use them, replenishing of supplies, ongoing supervision and monitoring, or other systems issues. Not surprisingly, most of these efforts fizzled out within a few months of inception.

2. Improvements implemented

Efforts to better address prehospital care in Ghana gained political support in the early 2000s – partly the result of long-term advocacy work by health professionals and concerned members of the public. Such advocacy gained ground after the stadium disaster in the capital, Accra, on 9 May 2001, in which more than 120 people lost their lives. Most were trampled to death during a disturbance after a football match. The lack of disaster management or any organized approach to prehospital care in the face of such a mass-casualty incident was highlighted in the press and in national discussions.

The following year, Ghana's head of state, His Excellency John Agyekum Kufour, in his Annual Sessional address to Parliament, charged the Ministry of Health and its collaborators to establish a Nationwide Ambulance Service – to provide effective prehospital care to trauma casualties and transfer them to hospital. As a result of this directive and the immense efforts of officers in the health sector, the National Fire Service, the Office of the State Attorney and other collaborators, a fledgeling National Ambulance Service (NAS) was established in 2004. It was created by the Ministry of Health as one of its own agencies, but with input from other branches of government, such as the National Fire Service. It was charged with the task of providing prehospital care to the sick and the wounded, and ensuring proper and adequate transfer of patients and casualties to health facilities.

The NAS started with seven pilot stations in three of Ghana's 10 regions. Fifty-seven firemen and women from the National Fire Service and six drivers engaged by the Ministry of Health were trained

as Emergency Medical Technicians (EMTs). These officers staffed the seven pilot stations during the 15-month trial phase (late 2004-2005). Managing the seven pilot sites unearthed numerous challenges and difficulties, which in the long run provided much-needed operational experience to both the ambulance crews and the programme managers. The lessons learned and experiences gained influenced the expansion of the ambulance stations.

The NAS moved into full-scale operations during 2006. By the end of that year, the number of ambulance stations had risen from seven to 19 and by the end of 2009 there were 24 stations with two control rooms in Kumasi and Accra. With this growth, the NAS has developed a three-tier administrative structure:

- *National Headquarters (HQ)*: The management team is made up of permanent Ministry of Health staff. The main task of HQ is to formulate policies, advocate and lobby for resources, facilitate the passing of the NAS bill, train EMTs and map out the direction and strengthening of NAS structures. HQ staff include the director, operations manager (who handles a variety of issues, especially ensuring the vehicles are well maintained and ready for use), logistics and supply coordinator (a senior EMT who ensures adequate quantity and quality of equipment and supplies in the vehicles and at the stations), human resource manager, clinical auditor (a doctor, hired part-time, to review the ambulance run sheets and summary data to ensure quality of care), accountant, two secretaries and two drivers.
- *Regions*: There is a Regional Medical Coordinator (RC) for each region (each of Ghana's 10 regions has a population of approximately 2 million people). The RC is a medical officer engaged on a part-time basis. The RCs liaise with the Regional Directors of Health Services (RDHS) and the Regional Fire Officers (RFOs) to run the region's ambulance service. The main task at this level is to give medical direction, supervise and support the activities of the stations, and act as a link between the HQ and the stations.
- *District/station*: This is the operational level of the ambulance activities. The EMTs are based at this level and each station is headed by an EMT leader. As many of the ambulances are based at fire stations, the EMT leaders report to the District Fire Officers (DFOs), who supervise and monitor the day-to-day activities of the ambulance crews. There is thus close collaboration between the NAS and the National Fire Service. The two control rooms (Kumasi and Accra) currently handle all incoming calls, informing individual stations as needed.

The foundation of the NAS is the corps of EMTs. During the pilot phase, the first batch of EMTs recruited were firefighters in the National Fire Service. They were jointly trained as EMTs by Ministry of Health and National Fire Service trainers. Since the pilot period, EMTs have been recruited and trained directly by the Ministry of Health, using National Fire Service training facilities. Courses are run when needed, as there is not yet a school in Ghana offering EMT certification.

Ambulances may be accessed by health facilities and by the public. This is done primarily by calling the dedicated emergency line (193) from landlines and mobile phones. However, people can also walk to the ambulance station or make a radio announcement through local FM stations.

The NAS has always carefully monitored the care it provides. For each ambulance run, paramedics record (on a one-page form) data that capture the nature of the problem and type of care provided en route. These data are reviewed by supervisors on an ongoing basis and are entered into a database for longer term monitoring. This comprehensive database allows monitoring of trends in service utilization, allowing better planning. It also allows monitoring of the quality of care provided by the paramedics, a priority of the NAS. This data system allows an in-depth understanding of the results of the NAS's work, as outlined below.



Ghana National Ambulance Service in action
© Ahmed Zakariah



National Ambulance Service dispatcher in the control room
© Ahmed Zakariah

3. Results

The NAS has created an organized and sustainable administrative structure, including clear lines of authority between different levels; adequate record keeping and use of data for monitoring, evaluation, and quality-improvement; and realistic and achievable standards for EMT training and for equipping the ambulances and stations.

This administrative structure has enhanced the sustainability and growth of the NAS since its inception 5 years ago. This is in contrast to what has happened in the past (in Ghana and elsewhere) where ambulances have been provided but used haphazardly, with no systematic planning.

Changes in the process of care are demonstrated by overall use of the NAS and by several performance indicators. Demand for and use of the NAS has grown steadily, from 205 cases handled in 2004 to 8250 in 2008 (see Table 1). This growth has been accompanied by greater efficiency of use. In the first 3 years (2004-2006 inclusive) there were many more calls than cases handled, because of false alarms or inability to find the location of the calls. These problems have diminished considerably in recent years.

TABLE 1 **Growth in use of the National Ambulance Service**

	2004	2005	2006	2007	2008
Calls responded to	546	2541	5551	8463	8114
Cases handled	205	1498	4442	7995	8250

Number of cases can be fewer than number of calls because of false alarms or inability to find site of call. Number of cases handled can be greater than number of calls because of multiple persons needing care at one site, such as in a motor vehicle crash.

In terms of the pattern of use, the top two conditions for which the NAS is called are obstetrical emergencies (23%) and injuries (22%). Inter-hospital transfers dominated the cases handled, accounting for over half of all cases because of the absence of dedicated ambulances in health facilities. However, during recent years the percentage of cases handled directly from residences or the roadside are increasing (Table 2).

TABLE 2 **Change in site from which calls received**

SITE	2006	2007	2008
Health-care facility	3343 (75%)	5986 (75%)	5317 (64%)
Residence	370 (8%)	838 (10%)	1353 (16%)
Roadside	459 (10%)	789 (10%)	1444 (18%)
Not Stated	270 (6%)	382 (5%)	136 (2%)
Total	4442	7995	8250

Total percentages may not add up to 100% because of rounding.

Several key performance indicators also indicate an improvement in quality of care, in terms of shortened prehospital times. The mean response time has decreased from 17 minutes in 2006 to 13 minutes in 2008. The mean scene time (case handling time) has decreased from 19 minutes in 2006 to 14 minutes in 2008. Among this, there has been better resource utilization, with overall vehicle-engaged times (e.g. time from dispatch until return to station and ready for next run) decreasing from 3 hours 7 minutes in 2006 to 2 hours 8 minutes in 2008.

Obviously, detailed data showing a reduction in prehospital mortality for victims of trauma or other medical emergencies would be ideal, but given the scarcity of data available on deaths outside the hospital (if not attended by the NAS), this is not possible yet. Nonetheless, it can be seen that there has been an improvement in process of care. Those cases that are transported directly from the site of a crash or other medical emergency now have access to trained staff – previously, not even basic first aid would have been available, and many ill or injured people would not have access to any form of transport. Likewise, those who are transferred from health facilities are now able to avoid the long delays that were previously the norm.

Increased use of NAS and the improved process of care have been achieved despite considerable obstacles, including lack of office accommodation at some stations and shortage of the appropriate calibre of personnel in the job market (the role of EMT is a new one in Ghana and there is no training school for it yet). There are also operational issues impairing the day-to-day work, including frequent false alarms, lack of street names and house numbers, little knowledge among local people of these names and numbers even when they exist, disrespect of sirens by motorists, and refusal of some health facilities at times to receive emergency cases. Likewise, funding has not kept pace with the growing demand for ambulance services.

So far, the National Ambulance Service has been funded from general revenue, directly from the Ministry of Health's operating budget. A total amount of US\$ 900 000 was spent on National Ambulance

Service activities during 2008 – mainly on EMT salaries and allowances, uniforms, training, vehicle maintenance, petrol and equipment/supplies for vehicles and stations. This amount does not include any new vehicle purchases. There was an initial purchase of 50 vehicles at the inception of the NAS and a subsequent international donation of an additional 36 vehicles.

In summary, despite the above limitations, the steady growth in use of the NAS bears witness to both the need for these services as well as sound planning for the services. This has included collaborative planning, involving stakeholders from multidisciplinary backgrounds; adequate medical oversight at the district and regional level; and adequate monitoring, supervision and quality control at the national level. The latter has been facilitated by adequate record keeping and collation of records to allow monitoring and oversight. All of these factors have been enabled by political backing from government.

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Mexico: Strengthening basic emergency medical services in Nuevo Leon State

1. Introduction and statement of problem

Injury has become a leading cause of death and disability in Mexico. This has been especially evident since the 1970s, when increased motorized transport meant the rate of road traffic crashes rose rapidly. The response to this problem needs to include both injury prevention and strengthening of trauma care. For trauma care, we need to consider ways to strengthen care provided in hospitals and also in the prehospital setting.

In Mexico, the great majority of injury deaths (over 70%) occur in the field (i.e. in the prehospital setting). In high-income countries, the percentage of prehospital deaths is lower (e.g. below 60%) indicating that in Mexico, more attention needs to be given to improving prehospital care.

This case study focuses on the state of Nuevo Leon, in northern Mexico. The state is a wide, arid area, with the 3 million population largely concentrated in the Monterrey metropolitan area. This state has the highest concentration of Mexico's industry. When road traffic crashes skyrocketed in the 1970s and 1980s, prehospital capabilities were gradually established. By the early 1990s most communities had an emergency medical services (EMS) system with fairly good coverage, so that the majority of people who needed an ambulance could get one. However, there was still considerable room for improvement. In each community there were often several EMS services, including the Red Cross, the Green Cross, and municipal services. Each service had its own telephone number. Each had its own station, usually near the centre of the town, with no coordination of day-to-day activities among the different EMS services. The result was often considerable delays in the arrival of ambulances, with an average response time¹ of 16 minutes in the city of Monterrey. Delays were more pronounced in areas of the state with a more dispersed population – especially in the poorer areas where street names were often not well marked and many roads were difficult to pass.

Moreover, the quality of prehospital care was variable. Most of the ambulance systems were staffed by combinations of paramedics with formal training, such as Emergency Medical Technician (EMT) certification, and those with on the job training and experience, but with no formal certification. In addition, there was no regular in-service training on trauma care or any other topics.

2. Improvements implemented

In an effort to improve upon the situation in Nuevo Leon, several steps were taken.

Infrastructure: The number of sites from which ambulances could be dispatched to attend emergencies was increased. In the early 1990s, the main EMS in Monterrey city was the Green Cross. This had two ambulance stations (to cover a population of over 1 000 000). To provide greater access and to improve response times, the number of dispatch stations was increased to four, dispersed widely across the city.

Universal telephone access numbers: To speed up public access to emergency services, many communities established universal emergency telephone numbers (e.g. 911) through which police, fire services and EMS could be rapidly alerted of emergencies. Dispatchers handling the calls could then send ambulances based closest to the site of the emergency. This eliminated the delays in initiating emergency response that used to result from people not knowing the telephone numbers for individual ambulance services, or calling an ambulance service that was not the one located nearest to the site.

Training: Probably the most significant improvements were the result of better paramedic training. Continuing education courses (e.g. short, 2-3 day courses for staff already working in the ambulance services, also known as in-service training) were first run in 1994 in the form of the Prehospital Trauma

¹ Response time refers to the time between a call being received in the EMS office and the ambulance arriving at the scene of the emergency.

Life Support (PHTLS) course for paramedics working for the Green Cross in Monterrey. This well-received course was seen as broadly suitable for all paramedics but was especially useful for those who had no prior formal certification (e.g. EMT certificate). This form of training has now become much more widespread in many other ambulance services throughout the state. PHTLS and the Basic Trauma Life Support (BTLS) courses are now conducted regularly and most paramedics are currently qualified through them (i.e. have taken and passed them in the past 4 years). There has also been an increase in the use of locally developed courses, created to meet specific needs. For example, a 2-day course on prehospital airway management has been developed and run by the Tecnológico de Monterrey School of Medicine.

In addition to these short courses, a growing number of paramedics are becoming formally qualified as EMTs. This has arisen partly through scholarships provided by some of the state's city governments, and partly through gradually rising expectations of paramedic skills. At the beginning of the 1990s, only around one quarter of full-time paramedics in ambulance services in the Monterrey metropolitan areas had EMT certificates. Currently, around 75% of all full-time paramedics in the area have them.

All these improvements in infrastructure, communication and training involved close collaboration between many stakeholders, including paramedics, directors of EMS services, area doctors with an interest in prehospital care, and city governments. Each brought their own expertise and resources to help accomplish these changes.

3. Results

The success of these measures was assessed in several ways, including monitoring the process of prehospital care and its outcomes (in terms of mortality). The increase in the number of ambulance stations had the desired effect, decreasing the average response time from 16 minutes to 10 minutes in Monterrey.

The increase in training likewise improved the delivery of prehospital care, increasing the provision of appropriate life-saving procedures. For example, after institution of the PHTLS course the percentage of patients in respiratory distress who received basic manoeuvres to keep their airway open increased from 16% to 39%. Likewise, the percentage of patients who underwent spinal immobilization increased from 39% to 67%.

These changes in the process of care were associated with an improvement in survival. Table 1 shows the comparison for three of the EMS services involved, before and after the improvements in training. Mortality of trauma patients cared for by two of the three services declined markedly.

TABLE 1 Changes in mortality of trauma patients handled by ambulance services in Nuevo Leon after several types of training programmes, 1999–2004

Site and type of training	Before	After
Monterrey – basic, short training	10.3%	7.4%
San Pedro – advanced, short training	3.4%	3.7%
Santa Catarina – basic, full EMT training	6.3%	2.5%

The EMS services with decreased mortality were ones in which basic training was emphasized, whether in the form of short in-service courses or full EMT training. In addition to demonstrating the effect of improved training, these outcomes show several other points. There was no decline in mortality in the city of San Pedro (change from 3.4% to 3.7% mortality was not statistically significant). This city already had a good basic EMS. The additional training provided there emphasized advanced techniques, such as endotracheal intubation. No improvement was demonstrated there, probably because once a good basic prehospital service has been established, more advanced techniques do not seem to add much further benefit in decreasing mortality. This reinforces the importance of more widely instituting

basic training and demonstrates that more expensive advanced techniques do not necessarily add much to basic capabilities.

Of course, the improvements noted above involved increased expenditure. The cost of the short, in-service training courses were each approximately US\$ 150 per student. Similarly, a 3-month EMT programme in the area costs US\$ 200 per student. These costs must be viewed in comparison to the average monthly salary of a full-time paramedic, which is around US\$ 300 per month.

The combined costs of the periodic refresher courses (so nearly all paramedics' credentials remain up-to-date), the improvements to infrastructure and taking on more paramedics to staff four (rather than two) ambulance stations were estimated have required an increase of 16% in the annual budget of US\$ 488 000 of the Monterrey Green Cross. This is not an inconsequential amount, but given the demonstrated benefit of these improvements, they have been continuously supported by local government. The number of dispatch stations has now been increased to seven and the in-service training has continued regularly since the first course in 1994.

One final point is on the importance of being able to document the effect of changes. Without an adequate record system, none of the EMS units discussed above would have known that their investments in infrastructure, communications and training were worth the cost. At the start of the improvements, all EMS units had only rudimentary record keeping, which would not have allowed an assessment of changes in mortality. A necessary component of the improvements was the institution of better record keeping. This included a one-page 'run sheet' on which paramedics recorded basic patient details, mechanism of injury, vital signs, procedures performed, and outcome. These forms not only aided long-term monitoring of the quality of care, but they also helped the paramedics carry out their day-to-day duties, requiring minimal additional time to complete. This improvement in record keeping was introduced at the same time as other changes, primarily to help track the effect of these changes. However, even after the completion of the initial projects, these forms continue to be used.

Thus, this case study demonstrates the cost-effectiveness of basic improvements in training and infrastructure in existing EMS services in Mexico. Similar improvements are probably possible in EMS services in other low- and middle-income countries.

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Colombia and Romania: Nationwide emergency medical services legislation

Almost every country in the world has responded to the challenge of trauma care, in hospitals and in the prehospital setting. In many cases there has been innovative and high-quality work done in centres of excellence. However, all too often, these centres of excellence are isolated. Improvements more generally are irregular and haphazard. Trauma and emergency care services for the population at large in whole areas (provinces or states) or even country-wide often remain patchy, with many areas having low-quality services, and with extensive lapses in coverage for some (especially rural) areas. This has particular impact in the prehospital setting, but the problem of irregular progress also affects hospital capabilities.

In efforts to make consistent improvements in emergency medical services (EMS), both countries in this case study recently passed nationwide health legislation encompassing EMS. This legislation sought to provide reasonable, affordable, achievable standards for the human and physical resources needed for different levels of hospital and prehospital services. Additionally, this legislation established mechanisms for government to ensure these standards.

Both case studies demonstrate the process of legislation development and give details of the legislation. The case study from Romania additionally shows the benefit of having a high-ranking Ministry of Health official authorized and empowered to enforce the legislation.

A. Colombia's first nationwide emergency medical services legislation and guidelines

1. Introduction and statement of problem

Colombia has a high burden of injury resulting from road traffic injuries, as do many other industrializing countries. However, Colombia's history of natural disaster and political and drug-related armed violence are also responsible for a large number of injuries. In response to this widespread need, a number of independent emergency medical service (EMS) systems arose in separate cities across Colombia. These individual EMS efforts evolved according to the resources available locally in each city, and therefore there was little consistency from one locale to the next. For example in Bogotá, the capital city, an EMS based on the French SAMU (System of Emergency Medical Assistance) had been developed, which included a doctor on board each ambulance. Smaller cities with fewer resources, such as Cartagena, Cali and Medellín had created response systems based on the public service sectors that were locally available – an amalgam of firefighters, civil defence volunteers and Red Cross volunteers. These different local arrangements made it difficult to organize EMS training and administration nationwide.

Because individual cities had different systems, their protocols and training of personnel differed greatly. Each department had different systems, levels of resources and terminology. Some emergency medical personnel had titles that had an alternative meaning in other cities, or simply did not exist in other systems. In time, the overall disorganization of Colombia's EMS systems became a concern to medical and paramedic personnel. If mass-casualty events occurred, requiring multiple EMS responses from different cities, the discrepancies between the EMS systems made coordination difficult. This situation became critical in 1985 when the Arenas volcano erupted, killing 22 000 people. Multiple EMS departments had to work together, with an inefficient and frustrating result. As a result, EMS personnel from different systems demanded standardization of training and overarching legislation to unite Colombia's EMS systems.

While the need was great, the solution was not straightforward. The diverse causes of trauma in Colombia necessitated a response system that could perform in basic and advanced capacities, and that could be effective in both rural and urban settings. Additionally, the system had to have the ability to respond to unconventional and complex situations. It would require a highly coordinated effort.



Before 2000, some cities had groups such as Civil Defense and Red Cross who ran basic life-support ambulances using different protocols

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2. Improvements implemented

In order to standardize EMS services and make progress nationwide, a broad-based consortium of stakeholders formed the Colombian Prehospital Care Association (ACAPH – Asociación Colombiana de Atención Prehospitalaria). The association included doctors involved in prehospital care, representatives of private and public ambulance services, administrators from hospitals that handled large numbers of trauma and other emergency patients, researchers from universities, and volunteer organizations such as the Red Cross, Civil Defense, firefighters, and volunteer rescue agencies. From its inception, ACAPH worked closely with the Ministry of Social Protection, the ministry in the Colombian government responsible for health.

The ACAPH had several objectives. First among these was to standardize training for different levels of prehospital care staff. The ACAPH, in conjunction with experts from the main Colombian universities, defined the curriculum for three key roles (in order of increasing expertise): nurse assistant, emergency technician and emergency technologist.

Second, the ACAPH sought greater government involvement in prehospital care. The Colombian government had already implemented an integrated quality plan for health care that standardized training, skills, resources and requirements for hospital-based health-care staff. This government legislation had resulted in improvements in coordination and quality of care in Colombian hospitals. The EMS community felt strongly that a similar legislative effort could streamline and improve their system as well, so the ACAPH set about creating recommendations to guide this legislation, and to create national guidelines for prehospital care and training which would then be built into national legislation.

One of the first steps towards achieving both of these objectives was to create guidelines for standardized training for the different levels of prehospital staff mentioned above. These guidelines built upon existing national practices and standards, along with international references, including the training curriculum in courses such as Prehospital Trauma Life Support and Basic Trauma Life Support. It also built on WHO guidance documents, *Prehospital trauma care systems* (WHO, 2005) and *Guidelines for essential trauma care* (WHO, 2004). As a result, in 2005, *the National Medical Prehospital Guidelines* were released as a collaborative effort by the ACAPH, the Instituto de Ciencias de la Salud (Health Sciences Institute) and the Ministry of Social Protection.

Once the ACAPH had made progress on their first objective – standardization of training for prehospital care staff – the group’s focus turned to their second objective: to help integrate prehospital EMS into government legislation. During the next few years, the Colombian government, with input from the ACAPH and other stakeholders, passed several pieces of legislation that helped implement a more organized approach to EMS nationwide. The ACAPH played many roles in this legislation, including advocacy and input of expert opinion. The latter was especially useful as the government had a limited budget to hire consultants to provide such input.

The first legislation that related to ACAPH’s initiatives was decree 3616 of 2005.¹ This focused on standardizing training for prehospital staff. The legislation on training programmes essentially drew on the recommendations that had been set out in the *National Medical Prehospital Guidelines*, specifying the roles and responsibilities of different levels of prehospital personnel.

One year later, resolution 1043 of 2006 was released. This resolution was an update of resolution 1043 of 2002, which set out a plan to promote quality in health care. The 2006 update integrated a prehospital and EMS component into the 2002 resolution and included the following points:

- Specific definitions for prehospital care, emergency management, initial emergency management, clinical health guidelines, clinical protocols, minor and major procedures, invasive procedures, basic life support and advanced life support, and job descriptions and related required educational levels for allied health professionals, such as emergency technicians and technologists.
- Technical requirements for staff and equipment for various levels of ambulance: transport ambulances, emergency ambulances and ambulatory medical care vehicles. Included in these were requirements for the basic data to be gathered by prehospital staff during their care of the patient.
- Technical requirements for staff and equipment for various levels of emergency room.
- Specific recommendations for nationwide implementation of the *National Medical Prehospital Guidelines* as a standard against which to assess ambulance services for certification.

An extension of resolution 1043, known as decree 1011 of 2006, established methods for auditing the quality of care provided by ambulance services. This decree specifically addressed accreditation of health services, including ambulance services. It provided definitions and rules about how quality should be measured, and how each service should monitor itself in relation to quality improvement. This included financial, technical and administrative aspects.

3. Results

The resolutions and decrees mentioned above have improved the structure and process of prehospital care in Colombia. First, the new legislation (i.e. the decrees and resolutions) sought to standardize prehospital training. In response, six national universities in five cities instituted formal prehospital training programmes to streamline and standardize preparation for a career in this field. These universities have developed the National EMS Technologist Curriculum, which drew from the ACAPH guidelines discussed above. To further advance the training of prehospital staff, the universities have created their own working group, the Asociación Universitaria Nacional de Atención Prehospitalaria (National Association of University Programmes of Prehospital Care). Thus, training for prehospital personnel is being given considerably more attention and is far better organized than it had been previously.

Second, the new legislation sought to establish minimum levels of quality and more consistent methods of operation for the diverse EMS services. As a result, there is now improved coordination among different EMS units when multiple units need to respond to an event. This was demonstrated during the response to the eruption of Nevado del Huila volcano in March 2008, after which EMS leaders voiced the opinion

¹ In Colombia, a ‘resolution’ is a rule or regulation issued by a ministry. It has the force of law, but only for workers inside the organization or office that made the resolution. A ‘decree’ is passed by the Colombian legislature and is obligatory for all citizens, making it more far reaching.

that coordination among EMS units had improved considerably. Likewise, a major disaster drill in Bogotá demonstrated a good state of coordination among local EMS units and international teams in October 2009.

Finally, there has been a fall in the nationwide mortality rate from injury. The overall number of injury-related deaths declined from 44 000 in 2002 to 28 000 in 2007. Conversely, the total number of non-fatal injuries increased from 215 000 (2002) to 282 000 (2007).² Thus, the case fatality rate among the injured has decreased during this period.³ Although difficult to prove, one of the contributing factors may be the improved EMS services resulting from the new legislation.

B. Legislation and creation of a government post for emergency medical services in Romania

1. Introduction and statement of problem

Between 1990 and 2000, Romania made progress in its provision of emergency medical services (EMS). A network of governmental ambulance services had existed in the country before 1990, and fire departments in some areas had also started running ambulance services. At the same time, several hospitals throughout the country had been upgrading and improving the organization of their emergency departments. Despite these important improvements in trauma and emergency care, Romania's EMS system remained extremely fragmented. The quality and availability of EMS depended on local county resources and motivation, both for prehospital ambulance services and hospital emergency care.

2. Interventions implemented

Legislation for EMS: In 2005, the Ministry of Health was considering legislation to improve health-care services, including a specific section on EMS. In order to draft the legislation and identify priorities, the Consultative Committee for Emergency and Disaster Medicine was created as an advisory body. The members of this committee were primarily doctors who were experts in this field. The committee had a purely consultative position with little decision-making power, but it was able to contribute to the legislative process. The Consultative Committee addressed both prehospital and hospital-based components of EMS and their input helped shape the EMS section of the *Health System Reform Law of 2006*. This law defined emergency care as a duty of the state, distinguishing it from other aspects of health care. A major implication of this is that emergency care for all is paid for by the state, whereas all other medical care is paid for by insurance or other means. At the time, the Ministry of Health financed this through the increased tax revenue coming from Romania's rapidly growing economy, in addition to a cigarette and alcohol tax.

In order to expand on this preliminary legislation, the Ministry of Health, with input from the Consultative Committee, outlined the criteria and definitions for different levels of hospital emergency departments in terms of staffing, physical resources and financing. The Consultative Committee also established standards for ambulances, detailing the resources required for each ambulance in terms of medications, materials and staffing.

In addition to the enacted legislation, the Ministry of Health has created several decrees that impact on EMS and that are part of the implementation of the Health System Reform Law. In partnership with the Ministry of Interior, which oversees the fire departments, the Ministry of Health issued interministerial decree 1092/1500/2006.⁴ This established the criteria for several types of ambulance vehicle, ranging from first response vehicles to mobile intensive care unit vehicles. The competencies of ambulance personnel were defined and the limits of what each level of personnel could perform in the field were established. Logistical and safety regulations were created and a partnership established with the police force responsible for enforcing these standards through spot checks.

² Injuries registered by the Legal Medicine Institute. This is based on legally mandated hospital reports of several types of injury, including violence, suicide, motor vehicle crashes and work-related injuries.

³ Case fatality rate implies the death rate among people who are injured. Nationwide, the case fatality rate among reported injuries decreased from 20% in 2002 (i.e. 44 000 deaths out of 215 000 injuries) to 10% in 2007 (i.e. 28 000 deaths out of 282 000 injuries).

⁴ The first number refers to the coding of the decree from the Ministry of Health (1092) and the second the coding from the Ministry of the Interior (1500).

In the hospital setting, the Ministry of Health issued several decrees that related to hospital capabilities for emergency care. Decree 1764/2006 established standards for different levels of hospital critical care capabilities (including intensive care units) and decree 1706/2007 defined standards for different levels of hospital emergency departments, including human resources, equipment, drugs and infrastructure. This expanded upon the levels of care that had been defined by the Consultative Committee. These standards included extent of diagnostic capabilities, available personnel, levels of training for personnel and treatment capabilities for each type of emergency facility. Emergency departments' capabilities are thus classified by exact criteria, ranging from Level I (regional hospital able to provide advanced emergency services) to Level IV (no emergency capabilities, must transfer all emergency patients).

Appointment of dedicated government official to administer EMS: In 2007, the Ministry of Health created a position specifically responsible for the administration of EMS and for implementation of the provisions of the EMS section of the Health System Reform Law. This position – Under-Secretary of State for Emergency and Disaster Medicine – is appointed by the Prime Minister at the suggestion of the Minister of Health. This position has autonomous decision-making power and has therefore enabled advances in the organization and administration of Romania's EMS. The Under-Secretary of State can influence, create and implement regulations, and can evaluate their implementation through inspections and audits. The position was funded by the Ministry of Health and was considered a relatively inexpensive improvement in terms of the possible changes that could be made in the EMS system. The responsibilities of the Under-Secretary of State include the ambulance services, the prehospital services provided by the fire department, hospital emergency departments, and certain other hospital-based emergency services, such as the appropriate referral of trauma patients from one facility to another. Responsibility for these various services is primarily by way of audit and monitoring, rather than by direct administrative control.

3. Results

The new role of Under-Secretary of State for Emergency and Disaster Medicine has resulted in a greater ability to implement the provisions of the Health System Reform Law, and the decrees related to EMS. This comes about in part through increased powers to inspect, control and monitor EMS services, such as ambulance services and emergency departments. For example, there is now the ability, whether by the Under-Secretary or designees, to make unannounced inspections. Likewise, previously hospitals could self-designate their level of emergency department capability, but the new decrees and Under-Secretary role allow for independent verification of hospital emergency capabilities. In addition, there is now authority to discipline units or services that do not handle finances well, and greater ability to make rapid modifications in the criteria for review and monitoring of hospitals and ambulance services, as needed.

Improvements in the ability to enforce legislation have resulted in a better structure for emergency care nationwide. Improved EMS services (compliant with new national standards) have increased from nine locations nationwide (out of 42) in 2006 to 32 by the end of 2009. Similarly, the emergency departments of all 64 of the main emergency hospitals (one in each county, plus several additional ones in Bucharest, and several specialized centres such as the national children's hospital) have been standardized and upgraded to meet nationally mandated criteria.

The decrees and the Under-Secretary role have also allowed the Ministry of Health to begin collecting data on prehospital, emergency and trauma care within its EMS. This is still in its early stages, but in the near future these data may be used to more regularly and quantitatively evaluate and monitor the components of the EMS system, with the intention of improving performance at each level of care. Such data will of course allow a more objective assessment of progress in improving emergency care. Nonetheless, with the preliminary data at hand, we can begin to see some improvements. For example, in Bucharest, after enactment of the decrees and increase in monitoring by the Under-Secretary of State's office, there has been a decrease in average ambulance arrival times from 30 minutes to 8 minutes.

In summary, both countries have enacted legislation to define standards and to assure more widespread quality of prehospital care nationwide. In both countries, trauma and emergency care professionals worked closely with government to define the technical details of the legislation. In Colombia, this was in the form of both input and advocacy by the ACAPH, a multidisciplinary professional society. Benefits of the legislation have included, among other things, establishment of increased numbers of training institutions using the new national training standards in Colombia, and increasing numbers of counties in Romania whose emergency medical systems meet national standards. In Romania, the creation of a high-ranking government position, authorized and empowered to enforce the new EMS legislation, has provided an additional, important means to ensure implementation of legislation.

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2. Hospital-based care

Thailand: Trauma quality improvement programme in Khon Kaen

1. Introduction and statement of problem

In 1991, Thailand's Ministry of Public Health estimated that approximately 1.2 million injured people received medical care at public hospitals. Of these, 600 000 were admitted to hospital and 25 000 died. Despite these alarming numbers, there was little detailed information on the characteristics of injured people and the trauma care they received. In the absence of this, the government of Thailand was limited in its ability to prevent injuries, hospitals were unable to identify ways to improve patient outcomes, and motivated individuals (both professionals and the public) were unable to advocate for more attention to be given to trauma as a public health problem.

At this time, resources for trauma care generally seemed readily available, given Thailand's growing economy. However, there was a sense among trauma care providers that insufficient attention was being given to the planning and organization of trauma care services. It was felt that trauma care was not being delivered as optimally as possible and that people were dying from medically preventable causes as a result. However, there was no way to verify this, or identify a solution. This case study reports the efforts to address these problems by staff at one of Thailand's major trauma centres in Khon Kaen, the commercial and political centre of north-eastern Thailand.

The population of Khon Kaen province is 1.7 million, though the medical facilities in Khon Kaen municipality serve a much larger population in surrounding rural areas. In particular, the Trauma and Critical Care Center at Khon Kaen Hospital handles a large number of trauma cases directly from Khon Kaen, plus others referred from a wide network of smaller rural hospitals.

2. Improvements implemented

Clinicians at Khon Kaen Hospital understood the immense burden of disease and economic cost created by the injuries presenting at the hospital, and wanted to find ways to improve the care of injured patients. Quality improvement (QI) programmes have been used as a low-cost way to improve trauma outcomes. While the value of QI programmes was first demonstrated in high-income countries, the advances made by these means have become increasingly recognized as an affordable and sustainable way to improve outcomes in all countries. This case study details the development of a model trauma QI programme at the Khon Kaen Hospital.

Establishing a trauma registry: In order to implement informed and meaningful improvements in trauma care, the first step was to establish a trauma registry in 1989. The main objectives of the trauma registry were to provide data that would allow for understanding of the frequency, severity and patterns of injury, and also identify how care of the injured patient could be improved. Specifically, trauma care clinicians wanted to improve the system used to deliver care, ensure that their hospital provided staffing and resources that matched the workload, and investigate complications and deaths among trauma patients. They also wanted to find ways these deaths could be prevented. The trauma registry eventually became part of an integrated trauma QI programme.

To set up the trauma registry at Khon Kaen, five teams were created, each with defined roles (Table 1). Office space was dedicated to the trauma registry project, which was seen as a key demonstration of the approval for the project by high-ranking hospital administrators. The support of hospital administrators and policy-makers was felt to be integral to the trauma registry's success. Other factors were also considered important during the design of the trauma registry. The useability of the trauma registry for stakeholders had to be well thought-out, and potential users, such as organizations involved in injury prevention or traffic safety, had to be involved. The data entry process had to be made as simple and streamlined as possible so that data could be collected consistently, with minimal loss. At the same time, a certain degree of flexibility needed to be maintained so that adjustments (such as new codes) could be made.

TABLE 1 **Teams, members and their responsibilities as part of the Khon Kaen trauma registry project**

<p>Project administration team</p> <p>The secretary of the Injury and Emergency Care Center</p> <p>The heads of the following sectors:</p> <ul style="list-style-type: none"> Injury and Emergency Care Center Surgery team Injury and forensic medicine Emergency ward
<p>Registry form record team</p> <p>Emergency ward medical record staff <i>Responsible for recording general data on forms</i></p> <p>Emergency ward nurse <i>Responsible for recording all data (except admission data)</i></p>
<p>Computer data entry team</p> <p>Four assistants in the emergency ward <i>Responsible for entering data into computers</i></p>
<p>Inpatient data recording team</p> <p>Two nurses <i>Responsible for recording remaining data on registry forms, including final diagnosis, injury severity scoring, cost of treatment, and final outcome</i></p>
<p>Data processing analysis and reports team</p> <ul style="list-style-type: none"> Programmer Office clerk

Use of the trauma registry in quality improvement: The trauma registry was used to improve the system that delivered patient care, and to help with injury prevention. In terms of patient care, the trauma registry was used to improve financial management, assist in insurance administration, provide information to police, help locate patients when families enquired about them, and perform audits for different departments involved in patient care. In terms of injury prevention, the trauma registry provided information on the epidemiology of injuries, including frequency, severity, populations affected, and trends, all of which was valuable to groups and governmental departments using injury data for prevention activities.

The use of trauma registry information to improve the quality of patient care was quickly expanded upon. Several QI methodologies were applied, as described in Box 1.

Data from the trauma registry were used in conjunction with the QI methodologies described in Box 1 to evaluate and improve care of injured patients. One method of determining the adequacy of care was to evaluate care for a group of patients who died from low-severity injuries or from injuries that could probably have been treated successfully, such as single-organ intra-abdominal injuries, or injuries associated with airway obstruction. These deaths would be defined as 'medically preventable'. A review of data from the trauma registry revealed there were around 80 such medically preventable deaths per

BOX 1 Methods used by Khon Kaen Hospital trauma QI programme

- *Participatory action research.* This process involves several steps: identifying the problem and its root causes; generating ideas on potential solutions; implementation of selected solutions and evaluation of results. Data from the trauma registry were used to identify problems with patient care, either in prehospital, emergency room or inpatient management. Once problems were identified, their root causes were determined. In order to develop potential solutions, a multidisciplinary team was formed to discuss possible interventions and select the most appropriate ones. These solutions were then implemented by designated teams and the results evaluated – again, through data available from the trauma registry.
- *Peer review.* The data gathered and processed in the trauma registry were evaluated through a peer-review process. In peer review, medical or professional colleagues hold meetings during which medical care is reviewed and discussed with the intention of identifying deficiencies and finding ways to improve care. This can be done through regular monthly meetings, random review of patient records, or teaching conferences, such as grand rounds. The most critical aspect of peer review is to maintain a supportive, blame-free environment. Only when cases are reviewed in a non-accusatory manner can this process be productive.
- *Medical audit.* Medical records are reviewed to assess the quality of patient care delivered. This process relies on pre-defined criteria of acceptable medical care. Selection of clinical records for review can be random, defined by specific events (mortality, pre-determined complications) or an exhaustive review of all patient records. Once cases to be audited are defined, relevant information is extracted and presented to an audit team for discussion and recommendations for improvement.

year, representing more than one third of all trauma deaths. Thus, it appeared there were a large number of deaths at the hospital that could be prevented by improved trauma care.

Based on these findings, a Trauma Audit Committee was formed to undertake a peer-review investigation of the deaths of all patients who had a high probability of survival. The team found several common problems they believed were critical to patient outcome, and therefore potential areas for improvement.

General problems:

- Inaccurate or delayed diagnosis of critical injuries.
- Inadequate (poor) resuscitation in the emergency department, including inadequate administration of intravenous fluid for patients in shock, and inadequate handling of the airway for patients with airway obstruction.
- Inadequate emergency care during referrals from other hospitals.
- Low ability to monitor and evaluate the quality of trauma care on an ongoing basis.

Operative problems:

- Delay in operative care, often related to communication problems among staff, such as difficulties in rapidly alerting surgeons to the presence of patients needing emergency procedures.
- Delay in intra-operative recognition of life-threatening injuries.
- Missed or delayed recognition of fluid and electrolyte imbalances.
- Errors in intra-operative decision-making or in the operative procedure itself.

After identifying the common types of errors made in these two contexts, the Trauma Audit Committee then categorized them as either 'errors in care' or 'systems errors'. The findings of the Trauma Audit Committee were reported to the Surgical Care Lead Team, who set up a task force to develop performance indicators for trauma care. Performance indicators are process of care measures that can be tracked and monitored through the trauma registry. These indicate the quality of care being delivered and, where it is not up to the desired standard, they can serve as triggers for corrective action. A total of 27 performance

indicators were developed by the Surgical Care Lead Team. These are updated approximately every two years by the task force. Examples of performance indicators used by the Khon Kaen QI programme are shown in Box 2.

BOX 2 Examples of key performance indicators monitored by the Khon Kaen Hospital trauma QI programme

- Penetrating injuries should be explored within 1 hour of arrival.
- Long-bone fractures should undergo fixation within 48 hours of arrival.
- Exploratory laparotomy should be performed within 1 hour of admission in hypotensive patients (defined as systolic blood pressure less than 90 mmHg) with abdominal injuries.
- All patients with a Glasgow Coma Scale score of under 13 should receive a computerized tomography scan of the head within 4 hours of arrival.
- All patients with multiple or severe injuries should receive a chest X-ray.

Once performance criteria were established, the Surgical Care Lead Team agreed upon a series of solutions for each problem identified. These solutions were specifically targeted at the problems identified above.

Reducing problems with communication within the hospital.

- Radios were provided to all doctors on duty to facilitate communication; peer-led spot-checking of radios was done daily and doctors evaluated were informed of their performance.

Reducing problems with inadequate resuscitation and delays in care.

- Senior surgeons were stationed in the emergency department during the peak trauma times (the afternoon shift), in order to better supervise the junior doctors (residents, interns) who provided most of the care in the emergency department.
- Improved orientation on trauma care was provided to trainees joining the trauma team.
- Longer term, an emergency physician training programme was established (enabling senior staffing in emergency departments 24 hours a day) and a system of trauma alert teams was established (providing rapid response of other specialists to the emergency department).

Reducing problems with care given to newly admitted patients to the intensive care unit or emergency department.

- Chief resident/intern or senior staff/intern teams were specifically assigned to monitor patients in the intensive care unit who were thought to be in a very critical condition.

All suggested improvements were assigned to designated teams charged with implementing them and monitoring their progress. In addition, as noted above, the entire process for monitoring the quality of trauma care was improved through the QI programme, including improved information provided by the trauma registry and the key performance indicators, an improved peer-review process provided by the Trauma Audit Committee, and an increased ability to institute corrective action to fix problems provided by the Surgical Care Lead Team.

Although the main thrust of the QI programme at Khon Kaen was to improve hospital care of trauma patients, the trauma registry data were also used to determine deficiencies in patient care during transfer and referral of injured patients. As substantial deficiencies were noted, a trauma referral improvement plan was created to improve the trauma system in three areas: staff development, service system development, and communication and data system development. A series of interventions at both the provincial and community levels included formalized training for new personnel, monthly academic conferences for doctors, establishment of a code of practice during referral, and development of a communication system for referrals.



A trauma quality improvement programme improved trauma care and lowered trauma mortality in Khon Kaen Hospital
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3. Results

The outcome of the QI programme can be seen in two main ways: improved process of care and lowered mortality. The improved process of care was monitored through (and can be demonstrated by) changes in several of the key performance indicators and pitfalls (delays, errors, and system inadequacies, see Table 2). Most of the pitfalls decreased, including delay and error in diagnosis, error in treatment, and system inadequacy. Only error in technique did not change appreciably. Moreover, the number of cases in which the error noted contributed to a death decreased even more dramatically. In 1994, a total of 265 pitfalls (65% of all pitfalls) were felt to have contributed to the death of a patient. In 2000, this had decreased to 88 pitfalls (56% of all pitfalls) contributing to the death of a patient.

TABLE 2 **Decreases in pitfalls in care of the injured, Khon Kaen Hospital**

Year	Number of incidents for each type of pitfall					Total
	Delay Dx	Error Dx	Error Rx	Error technique	System inadequacy	
1994	10	24	222	12	139	407
1995	13	8	172	19	89	301
1998	6	7	73	8	67	161
2000	3	12	102	18	21	156

Dx = diagnosis; Rx = treatment

In addition to improvements in care at the Khon Kaen Hospital itself, there were improvements in the process of care in the broader trauma system, deriving from the trauma referral improvement plan (mentioned above). Patients referred from outlying hospitals were better cared for and better prepared for transfer. Comparing 1997 and 2000, there had been improvements in the adequacy of the following process of care indicators for transferred patients: airway management (55% up to 78%), haemorrhage control (53% up to 68%), and splinting (44% up to 54%).

These changes in the process of care led to a lowering of mortality, both overall and among the category of preventable deaths. Overall mortality, among all admitted trauma patients, declined from 8% in 1994 to 4.6% in 2000, a decrease of almost half. Mortality was also evaluated among patients who had a high probability of survival (> 75%) based on their injury severity and international norms. Most deaths in this category of patients would be considered preventable. The death rate in this category also declined, from 3.2% in 1994 to 1.3% in 2000, a decrease of almost two thirds.

This case study has demonstrated how improvements in care and a substantial lowering of mortality can be achieved through affordable and sustainable measures that enable hospitals to better monitor the quality of trauma care delivered. These measures included establishing a formal trauma QI programme, which in turn was supported by the setting up of a trauma registry to provide reliable information for the QI programme to use. Such measures are eminently applicable to trauma systems and hospitals in other countries globally.

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Qatar: Initiating a new, formalized trauma service

1. Introduction and statement of problem

Trauma is a major cause of death and disability in Qatar. According to the International Road Federation, Qatar has one of the highest road traffic death rates in the region, at 19 deaths per 100 000 population. Without intervention, this rate will inevitably rise as the country becomes increasingly motorized. Falls follow closely as the second most common cause of death and permanent impairment, occurring mostly at construction and other worksites. With the exception of the elderly, for whom cardiovascular disease and cancer are the most common causes of death, trauma presents the greatest health risk to the people of Qatar. In fact, there are more years of life lost to trauma than to heart disease, cancer and infections combined.

The demographics for trauma patients in Qatar are quite unique compared to the United States, Australia or Europe. This is partly because of culture and partly because of the booming economy and construction happening throughout the Gulf area. So rather than having a balanced mix of male and female, the population of trauma patients is about 94% male and 6% female, with the majority of injuries (over 95%) being blunt injuries rather than penetrating ones.

Thus, the health-care system in Qatar has been faced with a growing volume of severe injuries with which to deal. Although there were fairly good resources and well-trained health-care professionals, the overall system and state of organization for handling trauma patients was not sufficient to deal with their growing numbers.

2. Improvements implemented

In order to address the growing numbers of severely injured people, a range of actions has been instituted throughout Qatar. These include better efforts at road safety and injury prevention, improved injury surveillance and improved prehospital emergency medical services (EMS). Each of these has been an important development. This report focuses on improvements in hospital-based care.

The main hospital caring for the injured in Qatar is the Hamad General Hospital (HGH), a 600-bed tertiary care facility with comprehensive medical and surgical capabilities. This hospital is administered by the Hamad Medical Corporation (HMC), which also manages several other medical facilities in the country. In 2007, HMC partnered with the University of Pittsburgh Medical Center in the USA to provide expertise to improve trauma care throughout Qatar, but particularly at HGH. Since 2007, many improvements have been implemented in trauma care at HGH. These have in common better organization and planning for trauma care services at the hospital, improved delivery of clinical trauma care, and better capabilities for monitoring and performance improvement.

Trauma Service: Prior to the inception of the Trauma Service in November 2007, injured patients were cared for as part of the overall patient load at HGH, with doctors and nurses caring for them alongside patients with other surgical and medical problems. In 2007, a specific, dedicated Trauma Service was instituted. This is an administrative and clinical entity designed to optimize outcome for the injured patient. It is a multidisciplinary service which brings together individuals with interest and expertise in trauma care. There is a Trauma Service Medical Director, who is a trauma surgeon consultant (e.g. fully trained specialist, or attending), hired specifically to upgrade trauma care at HGH and who has extensive experience in trauma care and developing trauma services. A second trauma surgeon consultant, with special qualifications in surgical critical care, oversees the care of patients in the trauma Intensive Care Unit (ICU).

The Trauma Service consists of four trauma teams, each led by a trauma surgeon committed to caring for injured patients, with special interest and expertise in trauma care (Box 1). Each team includes additional committed surgeons (four on each team) plus a critical care intensivist (i.e. a specialist in caring for patients on intensive care units).

The Trauma Service is supported by an experienced trauma nurse coordinator and trauma registry personnel who enter and analyze pertinent clinical data in support of the performance improvement programme. A clinical pharmacist and injury prevention coordinator attend daily trauma reports. The Trauma Service acts as an advocate for the patient and works to ensure that no findings are overlooked in the process of identifying injuries and prioritizing patient management. Commitment to caring for the injured is a basic requirement at all levels for participation in the Trauma Service.

In order to work effectively, the Trauma Service established early links with radiology, the blood bank, operating theatre, ICU staff and nursing at multiple levels to define the needs of the trauma patient, and establish care of the acutely injured as a priority in the hospital. Direct communications were held with surgical colleagues in orthopaedics, neurosurgery, paediatric surgery and other disciplines to gain their support and cooperation. These efforts were aided by action of the Board of Directors which, in June 2008, declared that HGH should develop a 'Centre of Excellence in Trauma Care'.

BOX 1 **Composition of the trauma team (including response and support members)**

Consultant trauma surgeon
 Team leader*
 General/trauma surgeons (4)*
 Nurses (5, with expansion capabilities based on need)*
 Radiologist*
 Respiratory therapist*
 Blood bank technologist*
 Trauma nurse coordinator
 Clinical pharmacist
 Social worker
 Trauma registrar
 Physical medicine and rehabilitation specialist

* At least one of each type of these personnel is in-hospital at all times and able to respond to trauma activations (i.e. emergency situations when an entire team is called to take care of the most seriously injured patients).

Trauma facilities and staffing: Care for injured patients is provided initially by a highly skilled trauma surgeon or surgeons, in the eight-bed Trauma Resuscitation Unit, located in the Emergency Department (ED) and staffed at all times by one of the trauma team surgeons and five ED nurses. A back-up trauma surgeon is always available in-hospital. For all patients requiring operation, the consultant trauma surgeon must be present in the operating theatre to supervise operative management. Upgrading the education and experience of the ED and ICU nurses is ongoing and is an important component of improving care. All trauma surgeons have completed both Advanced Trauma Life Support (ATLS) and Advanced Trauma Operative Management (ATOM) courses, both of which are provided by the Hamad International Training Centre.

A substantial improvement in the management of acutely injured patients has been collectively made through: an on-site clinical laboratory, nearby imaging facilities (including X-ray and computerized tomography (CT) scanner), protocol for the immediate release and transport of blood for transfusion, trauma activation protocols (which alert both the operating theatre and the blood bank, as well as the trauma team), and improved staffing and education within the trauma ICU.

Following resuscitation, the patient's care may take place in the operating theatre, in the 12-bed trauma ICU, or in the 30-bed inpatient trauma unit. The Trauma Service has priority of access to the operating theatre for all acutely injured patients and provides the clinical coverage for both the trauma



Trauma teams assembled at morning report of the Trauma Service, Hamad General Hospital

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ICU and the inpatient unit. The trauma ICU is staffed by a trauma surgeon and intensivist who work as partners in the care of the critically injured. An additional trauma surgeon is assigned to the inpatient trauma unit.

Monitoring of care. Having the right personnel is obviously a requirement for good trauma care. But it is also important to ensure that staff and physical resources are used optimally, so mechanisms to monitor quality of care are essential. On the Trauma Service, monitoring is done on a daily basis. Clinical care of patients is the focus of the morning trauma report, which occurs daily and is attended by three of the four trauma teams on a rotating basis. Rounds continue in the ICU and inpatient trauma unit.

In addition, to better ensure patients are receiving the most appropriate care for their condition, the Trauma Service has its own ongoing formal peer-review programme. The Performance Improvement/Patient Safety (PIPS) programme for the Trauma Service uses information gathered from aggregated data pools, as well as from individual events. Deviations from the standard are identified and brought to the immediate attention of the Trauma Nurse Coordinator and the Trauma Medical Director. A key component to this is that each trauma team member understands it is his/her responsibility to help effect change. Issues concerning patient care usually surface at morning report or via Trauma Performance Improvement (TIP) forms which are strategically placed throughout the hospital and can be completed by anyone. All issues raised on the TIP form are placed on the agenda for discussion at the monthly meetings. The trauma peer review uses a standardized process to classify events and formulate action plans as needed. Cases that vary from the standard of care or have unique circumstances are selected for multidisciplinary peer review.

This process is aided by having an enabling administrative structure, including several committees that meet regularly. The Morbidity and Mortality Conference meets monthly and reviews all deaths and complications. Summaries are submitted to the Trauma Performance Improvement Committee, the multidisciplinary peer review group, to decide whether deaths and major complications are preventable or not, and to review whether care has been appropriate. Issues that are system-based are placed on the agenda of the Trauma System Improvement Committee, which addresses prehospital and broader trauma system issues. The latter committee includes representatives from EMS and virtually every service which has an interface with the trauma patient, both clinical and non-clinical.

Education. Since its inception in 2007, the Trauma Service has had an active role not just in caring for patients, but in providing education to all of the different clinical and non-clinical staff that make up the multidisciplinary team. These programmes have ranged from formal education to informal in-service programmes. As education is an important goal of Hamad Medical Corporation and particularly of HGH, the inclusion of residents, medical students, nursing students, respiratory therapy students and radiology technologist students is a logical extension of the educational mission. All students participate in the care of injured patients in the Trauma Resuscitation Unit, the operating room, the ICU, and the inpatient and outpatient clinics. In addition, they are involved in a variety of trauma-related activities, including participation in teaching rounds, case conferences and lectures. Hamad International Training Centre plays a major role in the education and certification of trauma care personnel at all levels.

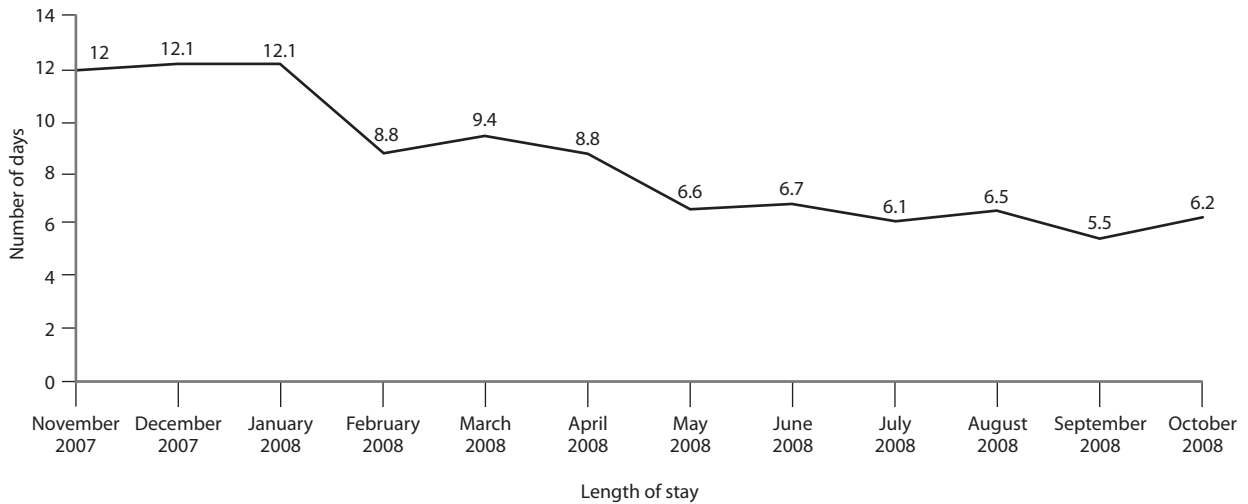
Rehabilitation. As rehabilitation needs to be an integrated part of the continuum of care, the Physical Medicine and Rehabilitation (PMR) Department is an important part of the multidisciplinary trauma team. The main objective of the rehabilitation programme is to prevent disabilities among patients with health conditions, with the ultimate goal of helping them reach their fullest physical, psychological, social, vocational and educational potential. This is achieved through the coordinated use of medical, nursing and allied health professional skills throughout the patient's hospitalization and beyond, from acute admission to community integration. It includes individual assessment by an interdisciplinary rehabilitation team, goal-oriented care and treatment, regular review, discharge planning and follow-up. The PMR Department is involved with the trauma patient while acute care is ongoing. They also identify those patients who will benefit from more intensive, longer term rehabilitation. After the acute care phase is over, these patients are then transferred to the 43-bed PMR unit at nearby Rumailah Hospital. Here, the most common conditions treated are traumatic brain injury, spinal cord injury and musculoskeletal trauma.

3. Results

The Trauma Service can, in itself, be defined as improved structure of care. It has increased the training levels of doctors as well as all other members of the multidisciplinary team that cares for the injured. It has put at their disposal more readily available equipment and supplies, and has created a more organized framework for the delivery of care. This has been accompanied by better monitoring of care through the PIPS programme, which has become a model within the whole hospital for doing quality improvement well. This improved structure of care has translated into improved process and medical outcomes.

In terms of process of care, communications have improved. There is now radio contact between ambulance personnel and the Trauma Resuscitation Unit, which was not previously present, and which allows for preparation and activation of trauma codes. Time from arrival to the Trauma Resuscitation Unit to the operating theatre for patients in shock and needing emergency abdominal operations has been reduced from an average of 60 minutes to 30 minutes. Blood products now arrive in the operating theatre with patients for emergency operations, whereas previously there were often long delays. In terms of medical outcomes, including resource utilization and costs, the average length of stay for trauma patients has been reduced from 12 to 6 days (Figure 1).

Figure 1 **Decreased hospital length of stay (2007-2008) following introduction of the Trauma Service**



These improvements have had other positive benefits, such as increased research activities and establishment of an international training site for the standardized Advanced Trauma Operative Management (ATOM) course. In 2009, HGH was the first international hospital to be officially reviewed as a level 1 trauma centre by the American College of Surgeons Trauma Center Verification Program. This is notable as the improvements entailed in the preparation for such reviews have been shown in studies from North America to improve both the process of care and medical outcomes (including mortality) of trauma patients.

Viet Nam: Improvements in trauma care capabilities in the network of health facilities in Hanoi

1. Introduction and statement of problem

Since the 1980s, injury rates have risen steadily in Viet Nam, mainly because of the increasing use of motor vehicles, especially motorbikes. This has placed a strain on the treatment capabilities of the health system. The response to this problem needs to include actions that address all aspects of injury control, including injury surveillance, research, prevention and improvements in care.

The site for this case study is Hanoi, Viet Nam's capital. Hanoi is a densely populated city with 6 520 674 people living in 2700 km². Surrounding the city are rural agricultural areas, which are also served by the city's health department. The Hanoi district (city, with surrounding rural areas) is served by a well-developed network of health facilities, ranging from commune health stations (providing primary care for areas of around 5000 people each), to district hospitals, city hospitals, and two tertiary care facilities. The tertiary care facilities are administered directly by the national Ministry of Health, while all other facilities are administered by the Hanoi Health Department. This network of facilities has served the area well, making significant achievements in terms of reducing many of the previously common infectious childhood diseases, and boosting life expectancy to 69 years.

However, the network of health-care facilities was overwhelmed by the rapid increase in trauma, and until the late 1990s there had been little systematic planning to address it. Some tertiary and city hospitals had fairly good capabilities, but trauma care capabilities were limited at commune health stations and district hospitals, even though many of them (especially those on major roadways) received large volumes of trauma patients. Similarly, prehospital capabilities were minimally developed. Until the late 1990s there was only one ambulance station serving all of Hanoi. Although there were up to five ambulances on duty at a time, they were overworked and thus frequently not able to respond promptly to emergencies. Response times¹ averaged 30 minutes and it was estimated that only 15% of severely injured people (e.g. those injured severely enough to warrant admission to a hospital) reached the hospital by ambulance. The remainder were brought by taxi, private vehicle, motorbike, cyclo (motorized, three-wheeled rickshaws), or bicycle, with no first aid having been provided.

2. Improvements implemented

By the late 1990s, the magnitude of the growing injury problem was becoming evident. Government, health-care professionals, non-governmental organizations and other stakeholders all became increasingly involved in meeting this challenge, improving the evidence base with which to work through improved injury surveillance (carried out by the Ministry of Health) and injury-related research (carried out by academic institutions). Many stakeholders became involved in road safety and other injury-prevention work, while others started to address trauma care. In a noteworthy effort to coordinate these different activities, a collaborative working group of stakeholders was formed, called the Working Group on Injury Control. This consisted of representatives of government, including the Ministry of Health, Hanoi Health Department, Viet Nam Red Cross, international organizations including UNICEF and WHO, academic institutions such as the Hanoi School of Public Health, and non-governmental organizations such as Counterpart International (CPI). Since 2002, these stakeholders have met regularly to better coordinate injury control activities for the country. Thus, trauma care improvements should be viewed in relation to the broader spectrum of injury control activities that were taking place nationwide.

As regards improvements specifically in trauma care, both the national Ministry of Health and the Hanoi Health Department became increasingly involved in strengthening trauma care services. In particular, the

¹ Response time refers to the time between the phone call alerting the emergency medical services and the time the ambulance arrives at the scene.

Hanoi Health Department issued a directive that the clinics and hospitals it managed should develop and meet rigorous standards for trauma and emergency care services. This policy addressed infrastructure, medical equipment, and training and staff development. Economic constraints meant there was little additional funding allotted for trauma care, but the policy created an environment in which efforts to improve trauma care were encouraged. In response to this, several related activities arose. Prehospital capabilities increased with the establishment of two additional satellite ambulance stations (in addition to the one main station in central Hanoi). This allowed greater geographic distribution of ambulances and thus shorter response times, and greater coverage of the population.

There were also efforts to increase capabilities in commune health stations and hospitals – the main focus of this case study. The characteristics of these facilities are shown in Table 1.

TABLE 1 **Hanoi Health Department facilities involved with trauma care**

Facility	Average capabilities for this level of facility
Commune health station	0-6 beds for overnight stays 5 nurses 1 doctor (general) 15 trauma admissions or emergency transfers (to hospitals) per month
District hospital	100 beds 100 nurses 20 doctors (total) 1–3 surgeons (general surgeons) 60 trauma admissions or emergency transfers (to higher level hospitals) per month
City hospital	200-300 beds 600 nurses 150 doctors (total) 20 surgeons (of all sub-specialities) 150 trauma admissions per month

Efforts to improve trauma care in this network of facilities included several related components. Firstly, training for health workers increased. Previously, it had been found that there was little by way of continuing medical education (CME) for doctors and nurses providing trauma care in the city. This was especially problematic for the commune health stations and the district hospitals, where there were few or no specialists with trauma expertise. Thus, CME trauma care courses were developed by several stakeholders working collaboratively, including the Hanoi Health Department and CPI. An in-depth curriculum was developed, along the lines of existing models such as the Advanced Trauma Life Support (ATLS) and the National Trauma Management Course (NTMC). Subject matter was adjusted to fit Vietnamese circumstances. Separate courses were developed for doctors and nurses. Highly effective teaching methods were used, including interactive lectures reinforced by skill stations.² A core group of trainers (surgeons and other trauma care specialists working in the Health Department) received special training-of-trainers courses in preparation for the course roll-out in Hanoi and more broadly in Viet Nam. New instructors were brought on as the CME courses grew, with emphasis on instructors receiving additional training themselves to maximize their teaching effectiveness.

These week-long courses have been used widely in Hanoi. To date, 320 doctors and 410 nurses have completed them, with the aim that most doctors and nurses working in the emergency departments in Hanoi Health Department facilities will eventually do the same. The courses have also been rolled out to 12 other Vietnamese cities, with an additional 295 doctors and 360 nurses having taken part.

In terms of physical resources (equipment and supplies), the Hanoi Health Department policy noted above provided an impetus to greater attention to detail in planning for trauma care capabilities at individual facilities. These individual efforts were aided by a city-wide trauma care needs assessment that

² Hands-on, practical training sessions during which participants practice techniques, such as on mannequins.

was carried out in 2002. This needs assessment was based on the criteria laid out in WHO's *Guidelines for essential trauma care*. This publication defined 260 items of human resources (staffing, training, skills) and physical resources (equipment, supplies) as either essential or desirable at health-care facilities ranging from rural clinics (such as commune health stations) to tertiary care facilities. Items designated as essential were those deemed to be the most cost effective and the most universally applicable to countries at all economic levels.

In the needs assessment, the status of each of these items was evaluated by site visits conducted by several external staff, including one or more of the following: Hanoi Health Department officials, national Ministry of Health officials, staff from CPI, and international trauma care experts. These outside staff interviewed the facility's staff regarding the overall capabilities of the facility for trauma care, the skill and training of staff, and the presence and functioning of physical resources. The review team also inspected the physical resources present. Each of the items on the checklist was rated as:

- **N/A:** non-applicable at that level of the health-care system
- **Absent** (and should be present): 0
- **Inadequate** (less than half of those who need this service or item receive it when needed): 1
- **Partially adequate** (most, but not all, of those who need this service or item receive it when needed): 2
- **Adequate** (virtually all of those who need this service or item receive it when needed): 3

Items were assessed not only on their physical presence but also on their timely availability for all who needed them. For example, a diagnostic test that could not be performed because the equipment was not operational while awaiting repairs would be ranked 1 or 2, even if the equipment for the test were present.

These needs assessments accomplished several goals. First, they provided a baseline for subsequent evaluation. Second, they sensitized staff at all levels as to the international standards for low-cost and sustainable trauma care capabilities. Third, the initial findings (next section) of widespread deficiencies in such critical yet low-cost resources stimulated city-wide improvements in trauma care capabilities.

Thus, in response to the call from the Hanoi Health Department to improve capabilities for trauma care, several related activities were undertaken. These included increased in-service training for doctors and nurses, and increased local capacity to regularly undertake such training; greater attention to planning for equipment and supplies; and improved managerial capability for administering trauma care, including instituting trauma quality improvement programmes in several of the hospitals. It is also important to state that these improvements were made in an integrated way, aiming to improve the trauma care capabilities of the entire network of commune health stations and hospitals administered by the Health Department, as well as to increase the capabilities for prehospital trauma care in Hanoi.



A training course on trauma care, Hanoi

© *Nguyen Thai Son*

3. Results

The success of these measures can be judged by examining the results of the needs assessments. These were conducted at baseline (2002) and then at two follow-up points: 2003 and 2005. A sample of health-care facilities at each level was selected, emphasizing those dispensing most trauma care. During these assessments, the list of 260 essential items defined in the *Guidelines for essential trauma care* was used. Table 2 presents a summary of a few key elements.

TABLE 2 **Assessment of trauma care capabilities in Hanoi area, 2002, 2003, 2005**

Item	Commune health station			District hospitals			City hospitals		
	2002	2003	2005	2002	2003	2005	2002	2003	2005
Number of facilities assessed	12	12	2	6	6	2	4	4	1
Skills									
Percentage of doctors with post-graduate training in trauma	0%	0%	30%	20%	40%	83%	25%	40%	50%
Percentage of nurses with post-graduate training in trauma	0%	0%	20%	10%	20%	24%	15%	20%	25%
Basic Life Support (BLS) skills	1	2	2	1-2	2	2-3	2	2-3	3
Advanced Life Support (ALS) skills	0	0	1	1-2	2	2	2-3	3	3
Physical resources									
Basic airway management	0	1	1	1	2	2-3	2-3	3	3
Advanced airway management	N/A	N/A	N/A	1	1-2	2-3	2-3	3	3
Chest tubes	N/A	N/A	N/A	1	2	2	3	3	3
Oxygen	0	1	1	1	2	2	2	3	3
IV fluids	0	1	3	2	3	3	3	3	3
Blood transfusion	N/A	N/A	N/A	1	2	2	2	2	3
Cervical collar	0	0	2	0	0	2	1	2	3
Backboard	0	0	2	0	0	2	0	0	3

Ratings in this table are: N/A (not applicable at that level of the health-care system), 0 (absent, and should be present), 1 (inadequate), 2 (partly adequate), 3 (adequate). Post-graduate training includes advanced specialization in a trauma care-related field, or having taken a trauma-related continuing medical education (CME) course, for those staff with trauma care duties.

The percentage of doctors and nurses with post-graduate training in trauma care (whether by advanced specialization or a CME course) increased at the two hospital levels (district and city). In response to this, the ratings for availability of staff with both Basic Life Support (BLS) and Advanced Life Support (ALS) trauma care skills increased, reaching the desired level at the city hospitals, and nearly so at the district hospitals. Availability of physical resources also increased steadily over the three rating periods for district and city hospitals, reaching the desired level for most of the elements at the city hospitals and nearly all at the district hospitals. Improvements in both human and physical resources were definite but less pronounced at the commune health stations.

These evaluations demonstrated the sustainability of the improvements in these low-cost items, as assessed over the 4-year period. One example of how these improvements in structural capabilities have been put to use in improving the actual process of care involves the performance of emergency endotracheal intubation. Prior to 2002, this procedure was performed only by intensivists (i.e. specialists in caring for patients on intensive care units). There were only a few of these at each hospital and they were not stationed in the emergency department. This led to occasional delays in airway management for some of the most critically injured patients. As difficulty in airway management is one of the leading causes of medically preventable deaths in trauma patients, it was decided that this capability should be targeted for improvement. The training efforts noted above included an emphasis on airway management, including endotracheal intubation, for surgeons and doctors staffing the emergency

department. There was also increased physical availability of the endotracheal intubation supplies in the emergency department. These measures increased the availability and timeliness of this emergency procedure. Table 2 shows the increased scores for Advanced Life Support under the skills section, and for advanced airway management under the physical resources section.

Accompanying these improvements at fixed facilities, there were also improvements in the structure and process of prehospital care. As noted above, there had been increases in the number of ambulance dispatch stations, thus allowing greater geographic dispersion of ambulances on duty. These measures were accompanied by increased numbers of and increased training for prehospital staff. Many of the participants in the CME training courses mentioned above included prehospital care staff, both doctors and nurses. In response to these measures, it has been estimated that response times have decreased from an average of 30 minutes in 2002 to 15 minutes in 2009. Likewise, coverage has gradually increased. In the late 1990s it was estimated that only 15% of severely injured patients (patients needing hospital admission) were transported to hospital by ambulance. By 2009, this is estimated to have increased to 26% – an increase, but one that indicates that a lot of work still needs to be done.

It is important to emphasize that these improvements in trauma care capabilities in Hanoi were low cost and have been sustainable. Costs have been incurred by the Health Department for the increased number of ambulance stations, and the CME courses (though these have drawn on outside funds too). However, the increase in physical resources at fixed facilities has occurred primarily by improved organization and planning, with no additional budget being allotted to them.

This case study has demonstrated how affordable and sustainable improvements can result in basic, high-yield capabilities for trauma care across a city's entire network of health-care facilities. These improvements came about primarily through improved organization and planning, with little additional expense. This case study has also shown the potential of standardized needs assessments to identify opportunities for low-cost but high-yield improvements, to monitor the progress of such improvements, and to serve as a stimulus for these improvements. The WHO's *Guidelines for essential trauma care* served as a basis for the needs assessments and are specifically targeted at trauma system development in low- and middle-income countries. Similar achievements are eminently achievable in individual institutions and networks of health-care facilities in countries worldwide.

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3. Rehabilitation

Brazil: Simplified rehabilitation programmes in a hospital in São Paulo

1. Introduction and statement of problem

The relatively fast economic growth and urbanization of Brazil in the past 30 years have dramatically increased the number of traumatic injuries, especially in the young male population. According to the Federal Health Department, the number of deaths resulting from external causes (primarily injuries, but also drowning, suffocation, and poisoning) reached 130 000 per year in 2006, accounting for 12% of all deaths. Injuries were the leading cause of death in people under 40 years. The main causes are falls, violence and motor vehicle injuries. The morbidity from injury has also increased, as indicated by the number of people admitted for diagnoses related to external causes, which rose from 54 915 in 1998 (3.3 admissions per 10 000 people), to 70 328 in 2007 (4.2 admissions per 10 000 people).¹

Trauma care services have attempted to keep pace with the rising rates of traumatic injury, especially in acute care. This has been done through increasing training and capacity for prehospital care and for emergency care in hospitals. However, until recently, longer term care of survivors, especially those with disabilities resulting from their injuries, had not received as much attention. In most Brazilian cities (and even more so in rural areas), there were typically few rehabilitation services in hospitals caring for injured people, or anywhere else for that matter. There were even fewer services available for disabled people once they got home from hospital, especially those with mobility and transport difficulties.

2. Improvements implemented

São Paulo, like all big Brazilian cities, has seen a great increase in the number of people with injury-related disabilities. The Orthopaedic and Traumatology Institute (IOT) at the Clinical Hospital of the Faculty of Medicine, University of São Paulo, a public referral hospital, receives the most severe cases of traumatic injury, including spinal cord injuries, hip fractures in the elderly, limb amputations and patients with multiple injuries. IOT is a 162-bed orthopaedic hospital that previously had no specialized rehabilitation services. However, demand for rehabilitation services increased exponentially during the 1980s and 1990s and patients with injury-related disability could wait for a year or more before getting a placement at a rehabilitation centre. This delay increased the number of secondary complications: contractures, pressure sores and infections. These complications could be so severe that potential functional gains would be dramatically reduced, even if rehabilitation services eventually became available. In the past 20 years, several rehabilitation centres have been created in the metropolitan area of São Paulo, but they cannot meet the growing demand for rehabilitation care. The majority of rehabilitation centres offer only outpatient programmes, which are not suitable in a large city like São Paulo, where some patients face long journeys from outlying parts of the city.

The IOT needed to respond to the increasing need for rehabilitation by establishing its own

¹ Source: www.datasus.gov.br

programme. Of the 1400 emergency admissions per month, around 50 have significant impairments that need extensive, long-term rehabilitation services: on average there are two patients with spinal cord injury (SCI), 40 patients with severe lower limb injuries primarily caused by motorcycle crashes (including amputations), two elderly patients with hip fractures, and 10 multiply-injured patients. Against this backdrop, IOT created a rehabilitation programme to improve functioning, prevent secondary complications and promote independence for severely injured patients.

This *Simplified Rehabilitation Programme* (SRP), which started in 1995, was at first developed for SCI patients and then extended to others. Its aims were: prevention of joint deformities and pressure sores; promotion of mobility and transfers (bed to wheelchair and vice-versa); bladder and bowel management; pain control; self-care independence; and caregiver training (especially for quadriplegics and elderly patients). The rehabilitation team also provided orientation for patients' home adaptation, including suggestions on home modifications to better accommodate patients' needs, such as bathroom handrails, enlarging doors, or building ramps to provide wheelchair access.

The SRP has a small team of professionals which includes a physiatrist, physiotherapist and rehabilitation nurse for the orientation work with patients and carers. In addition, a psychologist, social assistant and occupational therapist may be involved mostly for more severely disabled patients, such those with quadriplegia. The SRP team does not have its own specific unit in the hospital, but cares for patients on the general wards.

The programme needs no special or difficult-to-obtain equipment, and is primarily an educational programme. It usually starts as soon after surgery as possible, or when the patient has become clinically stable, with most patients starting in the second or third week after their injury. The team members train the patient and/or the caregiver in the following: passive movements to prevent deformities, changing positions to prevent pressure sores, skin care, self-catheterization, bowel management, and transfers. Also taught is self-care, including dressing, basic cleaning, bathing and sex education. Some simple adaptive devices for tooth-brushing, eating or dressing are provided if needed. Likewise, wheelchairs are prescribed, when necessary. The cost of a good wheelchair for most people with SCI (excluding those with special needs, such as people with high-quadruplegia who need wheelchairs providing trunk stability) is US\$ 300-500. The public health system provides the first wheelchair and a new one every 4 years. It may take some time (3-6 months) for delivery and thus some patients, if they and their family can afford it, prefer to buy the first wheelchair and after that try to get others in the public health system. In the past 5 years there have been some gradual improvements in the availability of wheelchairs, and reductions in delays.

Most of the patients remain in the hospital for around 2 months and during this time they receive care from the Simplified Rehabilitation Team (SRT). They return for their first follow-up evaluation 30-60 days after discharge and periodically thereafter as needed (for some this may be for the rest of their lives). These visits focus on general medical care and prevention of complications, and basic rehabilitative care to maximize function. In terms of comprehensive rehabilitative care, there is a *Divisão de Medicina de Reabilitação* (DMR – Division of Rehabilitation Medicine), which runs an outpatient clinic as part of the Clinical Hospital of the Faculty of Medicine, University of São Paulo. However, there is a long waiting period for people with SCI. Although part of the same university, the IOT and the DMR are located far from each other and there is no automatic transfer from the acute unit to the rehabilitation unit (because it has no inpatient capacity). Newly discharged patients usually have to wait 6 months to be accepted on a rehabilitation programme, and ultimately, only around 20-30% of people with SCI access outpatient rehabilitation. Thus, the SRT educates patients about preventing complications and finding appropriate medical care near where they live. To help do this, the social assistant provides information about local services, such as physiotherapists in their area.

During the first 3 years of the programme, a small number of people with SCI were treated (15-25 per



Members of the simplified rehabilitation team at the IOT: (left to right) social worker, physiatrist, occupational therapist, physiotherapist, physiatrist, nurse and psychologist

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year), and stays after completion of acute care were 15-30 days. As the programme grew and its capacity expanded, it provided a longer programme (30-60 days) to allow extra time for training people with SCI and their caregivers. The programme reached full capacity in 1999, by which time it was able to assist all who needed its services.

3. Results

From 1999 to 2008, the IOT received 424 new SCI patients, and its rehabilitation programme had a profound effect on the prevalence of complications among them. Rates of complications are compared with the 186 SCI patients treated in IOT during the period 1981-1991, during which time patients received no rehabilitative services during their acute hospitalization. At that time they were discharged to go home without any type of rehabilitative care for prolonged periods (average of 22 months) awaiting placement in a rehabilitation ward in a different hospital.

Table 1 shows that the proportion of patients who developed some type of complication decreased for all major categories of complication. The near complete disappearance of joint deformity is especially noticeable. After 1999, two new categories of complications (heterotopic ossification and deep venous thrombosis) were monitored. There are no comparison data for these complications. Nonetheless, the proportion of patients who developed them was low.

These results show that even simple rehabilitation care provided by a small team can prevent severe complications in people with SCI. The fact that this work was done with a small, trained rehabilitation team acting inside the general hospital, with very little in the way of equipment or supplies, increased the cost-effectiveness of the approach. The preservation of the link between people with SCI and the hospital after discharge also helped prevent complications.

TABLE 1 Complications in patients with traumatic spinal cord injuries: comparative data between 1981–1991 and 1999–2008, from the Clinical Hospital, Faculty of Medicine, University of São Paulo, Brazil

SCI complications	1981-1991 N=186	1999-2008 N=424	Percent reduction
Urinary infection	85%	57%	28%
Pressure sore	65%	42%	23%
Pain ^a	86%	63%	23%
Spasticity	30%	10%	20%
Joint deformity	31%	8%	23%
Heterotopic ossification	—	15%	—
Deep venous thrombosis	—	5%	—

^aPain: chronic pain that interfered with functional recovery.
N is the number of patients in each time period.

Source: Greve et al, 1994; Souza et al, 2009

Patients in the two time periods were fairly comparable in terms of age (mean 29 years before, 35 years after) and gender (70% male before, 84% male after). There was a difference in etiology, with 54% of patients in the before group having sustained gunshot wounds, compared to only 19% after. Level of injury in the before group was 65% paraplegic and 35% quadriplegic, while the after group was 59% paraplegic and 41% quadriplegic. Complete lesion (ASIA A) was 84% in the before group and 86% in the after group. (ASIA A relates to the American Spinal Injury Association impairment scale, which classifies the severity of spinal cord injury on a scale of A – complete loss of sensory and motor function, to E – normal function).

A well-trained team, preferably in a specialized unit, would be ideal in the treatment of SCI patients. However, these results show that even in a general hospital, a small but well trained team can make the difference between good and bad functional results.

Simplified rehabilitation programmes for other injuries

The large number of other disabling injuries (such as severe musculoskeletal injuries) and difficulties accessing adequate rehabilitation care led IOT to develop a range of other simplified rehabilitation programmes. These were mainly for elderly people sustaining hip fractures following falls, and for complex lower extremity injuries resulting from São Paulo's high rate of motorcycle crashes.

Hip fractures in the elderly

This programme was implemented to reduce mortality and improve the functional results for elderly patients sustaining hip fractures. Until 1999, there were no rehabilitation services available to these patients. The hip fracture rehabilitation programme was coordinated by an orthopaedic surgeon and a specialist in geriatric medicine, and included all elderly patients with hip fractures requiring surgery. As part of this programme, patients and their families were educated about the difficulties and incapacities that can arise after surgery, and how to deal with them. The team comprises: doctors (orthopaedic surgeon, geriatrician, others as needed), nurses, social assistant, physiotherapist and psychologist, as well as an occupational therapist (if needed). The aim of the programme is to get people walking as soon as possible, whether with or without a walking aid, and to prevent immobility and its complications (pressure sores, loss of joint movement, sarcopenia and infections). The programme typically starts immediately after surgery.

The programme also stimulates self-care independence. The rehabilitation team, as needed, goes to a patient's house and recommends modifications to facilitate the patient's independence. Patients selected for home visits include those deemed at high risk of poor functional outcome, based on clinical (e.g. higher co-morbidities), social, or family issues. The programme provides the physiotherapy needed for early mobility and addresses many other issues that can inhibit the resumption of mobility by elderly patients, including co-morbidities, poor socioeconomic conditions, lack of family support and inaccessible house environment. The programme addressed these issues through multidisciplinary interventions. For example, some of the environmental issues addressed included adapting bathing facilities, enlarging

doors, putting handrails on stairways, and removing obstacles that are potential fall hazards, such as loose rugs and certain types of furniture.

Severe lower extremity injuries

The increasing number of lower limb injuries is closely related to the growth in the number of motorcycles, mainly in metropolitan areas, where they are used for delivery service and individual transport. The motorcycle is a low-cost vehicle and is especially suitable for the heavy traffic of São Paulo, but the frequent, dangerous practice of bypassing heavy traffic by riding between lines of cars has contributed to the growing rates of motorcycle crashes. Lower extremity injuries are especially common in victims of these crashes. Many of the more severe cases end in amputations, sometimes after months and even years of treatment.

Every day, two new patients with severe leg injuries sustained in motorcycle crashes are cared for in the IOT emergency room. These patients often require prolonged treatment (6-24 months) and multiple surgical procedures. Despite treatment, a high percentage (10%) go on to lower limb amputation. Every week, four new patients with lower extremity amputations are admitted to the Amputation Group. The team comprises: doctors (orthopaedic surgeon and physiatrist), physiotherapist, occupational therapist, nurse, psychologist, social assistant and a prosthesis technician. Doctors evaluate all patients and a prosthesis is prescribed and fitted as soon as the stump is ready (i.e. after the early swelling has subsided). The prosthesis is paid for by the public health system and can take 6-8 weeks to be provided. During this time, patients receive physiotherapy orientation on how to take care of the amputated leg.

A 12-week training period is implemented after the delivery of the prosthesis. This includes adaptation to the prosthesis and gait training (both indoor and outdoor). This training takes place in the hospital, two to three times per week. Follow-up has shown that 75% of the people in this programme use the prosthesis continuously and are functionally independent. This includes 50% of people with above-knee amputations and 80–90% of people with below-knee amputations. Although there are no exact data available from the period before the start of the current Amputation Group, it is generally felt that fewer than 40% of the people received prostheses and were able to use them sufficiently well to become independent in the past, so the 75% rate currently represents a notable improvement.

Big rehabilitation centres with large teams and comprehensive rehabilitation programmes are necessary, but they are also very expensive. Developing countries with limited resources and epidemic numbers of injuries can benefit from basic rehabilitation strategies that are affordable and feasible, and which are effective at reducing the rates of complications and secondary impairments that often arise in severely injured patients.

The creation of a small and well-trained team in the general hospital could be part of the solution. Simple, basic, affordable rehabilitative care directed towards health promotion and prevention of complications, initiated soon after the acute phase of trauma care, can considerably improve the functional prognosis of patients with disabling injuries. In addition to the availability and training of such rehabilitation teams, it is important to emphasize the need for acute care doctors to recognize patients with disabling injuries, and to involve the rehabilitation team in their care as early as possible. This case study also demonstrates the importance of addressing all points along the spectrum of care, from acute care to early rehabilitation in the hospital, and to long-term follow-up of people with disabilities after their discharge. It also shows the importance of emphasizing the role of the individual in their own self care, and the importance of including family members and other caregivers in the rehabilitation process.

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India: Physical rehabilitation assistance to earthquake victims in Gujarat State – a sustainable approach in hospital and the community

1. Introduction and statement of problem

In Gujarat State, India, approximately 5% of the population is affected by disability. Until recently, and despite the need for rehabilitation services, resources for people with disabilities were very fragmented. The health-care system in Gujarat consisted of tertiary care facilities, including the Civil Hospital, district hospitals, community health centres (CHCs) and primary health centres (PHCs).¹ If a person had a spinal cord injury, he or she was usually referred to the Civil Hospital's Paraplegic Centre for treatment. Once the patient was discharged, there was no formal referral service to coordinate follow-up for them at the local community level.

On January 26 2001, an earthquake measuring 6.9 on the Richter scale struck Gujarat. Access to services and support for people with disabilities was already a big problem before the earthquake, and after the earthquake it became much more severe. In the Kutch District of Gujarat, the epicentre of the earthquake, an estimated 136 000 people were injured and 18 000 killed. The proportion of people living with disability went from 5% at baseline to 10% after the earthquake. With the increased number of injured people, the Civil Hospital Paraplegic Centre was overwhelmed, and needed to treat and discharge people even more quickly. When people with disabilities were discharged, they had no access to community resources, and returned home to families already overburdened with rebuilding their lives after the earthquake. Without proper follow-up or referral to appropriate resources, the prognosis for people with severe disabilities was largely poor. At that time, people with spinal cord injury had a 60% fatality rate.

2. Improvements implemented

In order to meet the above needs, an innovative project was developed to provide immediate services for the disabled population of Kutch, while simultaneously building the capacity of pre-existing organizations. The goal was to ensure sustainable resources for people with disabilities that would remain effective after the initial phase of assistance following the earthquake.

The project provided resources such as assistive devices (wheelchairs, prostheses etc), services such as physical therapy, technical support for pre-existing local efforts, and strengthened the network of resources at the community level for people with disabilities. Key factors emphasized by this project included:

- focusing on the strengths of the Ministry of Health and Family Welfare, the Civil Hospital Paraplegic Centre, and the Ministry of Social Justice and Empowerment;
- involvement of several local non-governmental organizations (NGOs), and community development organizations (CDOs), and the India office of an international NGO (Handicap International) with special expertise in rehabilitation;
- avoiding duplication of services already provided;
- a participatory planning process involving stakeholders;
- setting up mechanisms for planning, reporting, monitoring and coordination;
- integrating services into the existing health-care system;
- integrating community-based and hospital-based services.

The first phase of the project had three main objectives. Firstly, individuals with an injury-related disability had to be identified. This included identifying patients at the tertiary care level and connecting

¹ In India, District Hospitals are multi-speciality facilities typically serving populations of around 2 million. CHCs are small hospitals, emphasizing outpatient services, but with small inpatient services. PHCs are primarily outpatient clinics.

them with community health resources on discharge. Secondly, given the large number of disabled people in need of physiotherapy and orthopaedic resources after the earthquake, the project sought to provide direct care for people with disabilities. Although this was thought to be a necessary step in improving the care and functioning ability of disabled persons, the project partners did not want to limit their vision to short-term interventions. Therefore, while providing immediate and direct assistance, the project also defined a third objective, which was to identify ways of creating sustainable support for people with disabilities beyond the emergency phase of the post-disaster situation.

Objective 1. Facilitating follow-up for people with disabilities: In Kutchch, there were only two pre-existing physiotherapists, so the project brought in a team of two expatriate rehabilitation managers and 11 trained physiotherapists from other regions of India on short-term, 3-6 month contracts. A list of patients from Kutchch who had been admitted to the Civil Hospital Paraplegic Centre² was used to identify patients who might benefit from follow-up at the community level. When these patients were discharged, project staff notified the local health-care facility that the patient, who had a disability, would be returning home to their community. Additionally, physiotherapists in the nearest health facility were notified. These physiotherapists would then provide direct training for the person with a disability and their family on basic self care and monitoring and would perform joint assessments, supply basic equipment and follow-up with the patient and their family on an agreed-upon visit schedule.

While improved coordination helped those discharged from the Civil Hospital Paraplegic Centre, those had never attended the centre were left without help. In order to help this group of people, the project collaborated with local CDOs who had community development workers (CDWs) already in the field, either providing post-disaster relief or working on long-term development projects. These CDWs were to be trained in disability issues, so they could identify people who could benefit from the services provided by the project. In addition, project physiotherapists would train the CDW in basic support for people with disabilities, and conduct disability equity training.

The physiotherapists also proactively identified opportunities for integrating disability issues into development projects already underway. For example, as schools or health centres were being built, project staff provided input on how to ensure new buildings would be accessible for people with disabilities.

Objective 2. Direct rehabilitation services: In order to achieve the second objective, providing immediate direct rehabilitation services, the project prioritized individuals in high-risk situations and supported more than 500 of these individuals with direct physiotherapist home care. If orthopaedic services were needed, the existing government outreach services were accessed where possible. For those for whom this was not possible, services and supplies were directly provided. Spinal cord injury kits were provided to approximately 70 people (Box 1) and 152 sets of crutches, 22 wheelchairs and 36 tricycles were supplied directly to people with disabilities.

BOX 1 Spinal kits provided in Gujarat, India

Spinal kits were provided to people who had disabilities from spinal cord injuries. A combined physical, housing, and socioeconomic assessment was done for each person to tailor the kit to individual need. The kits include items from the following list:

- mattress
- mackintosh cover
- commode
- catheter
- mirror
- nail cutters
- bed pan
- wheelchair
- tricycle
- pressure-relieving cushions
- walking frame
- dressing supplies
- exercise blocks

² The Civil Hospital is located in Gujarat State's largest city, Ahmedabad, which is 250 km from Kutchch District.

The infrastructure of the Civil Hospital Paraplegic Centre itself was strengthened through a one-off improvement of hospital beds and pressurized mattresses, reducing the incidence of pressure sores in patients with spinal cord injuries. This provision of direct assistance improved the quality of care received by injured people at the hospital when the patient volume was at its highest, immediately after the earthquake.

All of the project's direct service provision was done on a short-term basis, with careful emphasis on capacity building and avoiding duplication. Existing health-care institutions and resources were utilized when available. When not available, direct care was provided by external staff (e.g. therapists from other locations in India), but with simultaneous development of local resources and personnel to take on these roles.

Objective 3. Sustainability through partnership: A broad partnership of organizations was critical to the third objective, which centred around providing sustainable support to persons with disabilities in Kutchch. This included the Department of Health and Family Welfare, which directly runs the network of government health facilities in the state and oversees all health care provided in the state. One of the facilities run by the Ministry of Health and Family Welfare is the Civil Hospital, with its Paraplegic Centre. Another key organization was the India office of Handicap International, which helped to mobilize resources for the project and to coordinate the input and services of outside rehabilitation professionals. Through this partnership, the patient discharge referral network that had been established was expanded. The social workers at the Civil Hospital Paraplegic Centre, who were normally responsible for discharge issues with patients, were trained in disability issues and support services. Additionally, each social worker was given information on local community services available to persons with disabilities so that they could appropriately advise patients who were being discharged.

At the community level, CDWs from organizations who had remained behind after the initial disaster relief phase received in-depth training on disability issues. This included: identifying people with disabilities; providing basic care for people with a disability; identifying individuals with specific conditions so they could be included in community support groups; and referral of people with disabilities to an orthopaedic centre that had been developed by the Blind People's Association, a local CDO (see below). The CDWs were trained how to use local resources to improve access in the home for disabled persons. One example of this is the use of bamboo poles, made at little or no cost, to create parallel bars. The family of the person with the disability could easily maintain and replace these using locally available materials. The CDWs were also provided with a list of resources for specific patient profiles so they could easily refer patients to the appropriate resources.



Assistive devices that were made locally and could be maintained and repaired in the community (e.g. knee braces, pictured) were part of a broad, holistic approach to improve the date-to-day lives of people with disabilities in Gujarat, India

© Nitin Upadhye/Handicap International

Another local CDO that was an integral partner was the Organization for Development Education (UNNATI). UNNATI is a capacity-building development organization with extensive experience working with minority groups and vulnerable populations in non-disability related projects. They had specific understanding of how to work in the community and cultural context, and were highly motivated to integrate disability issues into their activities. UNNATI created and published educational materials on inclusion of people with disability, advocacy for the rights of persons with disabilities, and caring for their basic needs, and these materials were used by CDWs and others for community education on disability issues. Other partners provided technical expertise. This partnership allowed messages about disability identification and equality to be communicated successfully in the local context.

After the earthquake, a number of NGOs and CDOs began providing assistive devices for people with a disability, but the efforts were uncoordinated and often not sustainable. The technology used for assistive devices was often not compatible with local resources, rendering maintenance, repair and long-term use of the devices impossible. Also, lack of coordination resulted in duplication of services, as well as poor assessments and allocations of devices. Thus, the project sought out organizations providing devices and partnered with them to develop long-term plans and work collaboratively to improve sustainability. Improvements included: machinery for the orthopaedic workshops; improved assessments for proper fitting of wheelchairs, prostheses and other devices; technical workshops; and advocacy for sustainable products.

Prior to its destruction in the earthquake, the old Kutchch District Hospital had not provided physical therapy or rehabilitation services. The Blind People's Association therefore invested in creating a long-term orthopaedic centre, which was set up near the planned site for the new district hospital. To complement the Blind People's Association's resource mobilization, Handicap International provided technical expertise aimed at making the new orthopaedic centre sustainable, and advising on assessment methodology, systems organization, cost reduction and recovery plans, and equipment maintenance. The administration of the hospital integrated the centre into the new hospital's ongoing operations. This partnership continued through the initial operational phase of the orthopaedic centre, during which time physiotherapists at the centre identified issues or technical areas that needed strengthening, while other partners organized workshops to ensure continual capacity building. As organizations that had been providing services to people with disabilities pulled out of Gujarat, project partners consolidated patient lists and referred them to the orthopaedic centre to ensure they received follow-up support.

The government sector also worked with NGOs to improve training on disability issues. Community-level health-care workers at PHCs and CHCs underwent training in identifying people with disabilities. The CHC's provision of rehabilitation services was strengthened. The government paid for a physiotherapist's salary, while Handicap International provided the training and technical expertise. This programme ultimately allowed CHC physiotherapists to replace the external physiotherapists brought in at the beginning of the project. In addition, government doctors and health professionals underwent disability training. Two curricula were provided: one as continuing medical education given to established health-care workers, and another for new doctors in training.

3. Results

The interventions made by in this project to improve care for people living with disability after the Gujarat earthquake created marked improvements at several levels.

Structure:

- Increased awareness among community, family members, people with disabilities and professionals on prevention of disability and bringing disability management initiatives into mainstream development activities.
- CDWs trained in disability – identification, basic care, criteria for referral, understanding what services are available in the area, and inclusion of people with disabilities in development initiatives.

- Strengthened primary health care (including CHCs and PHCs) – physiotherapists hired; doctors, nurses and other health workers better skilled in the prevention of disability, early detection of people with disabilities and appropriate intervention and referral. For example, between April and December 2003, 275 health workers were trained. An evaluation at the end of this period showed a high level of knowledge retention, with many workers able to identify children with disabilities under 10 months of age.
- Improved equipment and infrastructure for physiotherapy and other aspects of facility-based rehabilitation at the Civil Hospital Paraplegic Centre and in Kutchch.
- Increased linkages between government (health and rehabilitation) and non-government agency networks to ensure access to existing services and facilities. Likewise, increased linkages between different parts of government, such as the Ministry of Health and the Ministry of Social Justice and Empowerment.
- Improved inclusion of people with disabilities in the reconstruction and development process. For example, eight visually impaired physiotherapists were trained and staffed NGO-run rehabilitation facilities.
- Improved community capacity to provide community-based rehabilitation to people with disabilities and capacity to integrate them into existing activities. After the project period, 84 (66%) of the 128 villages in the worst-hit areas were covered by community-based rehabilitation services.

Process of care:

- Increased proportion of people with paraplegia had access to both hospital-based and community-based rehabilitation services. For example, from a total of 101 people with spinal cord injury related to the earthquake who were discharged from the Civil Hospital, 84% received rehabilitation services, either community-based (72%) or from an alternative rehabilitation facility (12%). Previously, very few people discharged with spinal cord injury would have had long-term, post-discharge rehabilitation, and virtually no one would have received rehabilitation services in the community.
- Improved district-level provision of rehabilitation services, including improved rehabilitation services at the district hospital. It also included better coordination between government health providers at different levels, and between government health providers and non-governmental organizations, with mechanisms for referral, treatment and follow-up, ensuring improved access and continuity of service.
- Improved provision of rehabilitation services at the primary level, including both PHCs and CHCs.

Outcome:

- 5-year mortality among paraplegic people after hospital discharge declined from 60% before the project to 4% afterwards.

This case study shows that overall care – and particularly rehabilitation services for people with disabilities – can be considerably strengthened in an affordable and sustainable way, with notable improvements in outcome, even in a low-income, post-disaster setting. This was accomplished through a spectrum of efforts at health-care facilities and at the community level. Likewise, stakeholders from different backgrounds were involved, with their actions magnified by their collaboration. These included community development workers, the government health sector, people with disabilities and their families, and NGOs. The ingredients for such success are present in almost every place where there are people with disabilities.

The activities reported in this case study were initiated in 2001–2 and, at that time, were focused primarily on spinal cord injury. These activities are the main thrust of this case study, but as the project proved successful and grew, it was broadened to include all types of disabilities and many other districts in the state. It now encompasses the entire state of Gujarat and disability-related activities have been integrated into all levels of the government-run health-care system.

4. System-wide improvements

Canada: Improving the trauma system in Quebec Province

1. Introduction and statement of problem

In 1990, among the population of 8 million in Quebec Province, approximately 53 out of 100 000 people died annually from injury. In an attempt to reduce the burden of injury in Quebec, trauma care clinicians and the provincial government looked at ways to improve trauma care. A baseline assessment carried out in 1987 showed significantly higher mortality rates for injured people in Quebec in comparison to injured people treated at many other hospitals throughout Canada and the United States.

Improving system-wide organization and planning for trauma care services had reduced mortality in other locations, and it was felt, therefore, that applying similar methods in Quebec might also improve patient outcomes. Before 1993, the trauma system in Quebec consisted of ambulance services and hospitals of varying sizes and levels of capability. There were no systems to regulate prehospital triage of injured patients, which meant that each injured patient was taken to the nearest hospital, regardless of the patient's injury severity or the receiving centre's ability to provide specialized trauma care. Inter-centre communication to facilitate the arrival, referral and transport of patients was non-existent. Additionally, there were no prehospital treatment guidelines or mechanisms for quality control. Each hospital was free to determine its own capabilities, with no province-wide, uniform standards.

The Quebec provincial government prioritized trauma care in 1990, partly as a result of the 1987 assessment, and embarked on a sequence of quality improvement interventions targeted at the regional trauma system, with consistent evaluation and modification.

2. Interventions implemented

Trauma registry

One of the key components for implementing change in Quebec's trauma system was the availability of a province-wide trauma registry. This was initially created from several individual hospital registries. As the trauma system grew, the registry also grew to include data from all the major hospitals providing trauma care, and eventually encompassed all patients admitted for injury at any hospital in the province. This tool allowed evidence-based decisions to be made. It also allowed evaluation of the effects of the various interventions implemented in the Quebec trauma system.

Patients included in the trauma registry were defined as having: an injury causing death; admission to the hospital with length of stay greater than or equal to 3 days; admission to an intensive care unit; or transfer from one hospital to another. A subset of patients was defined as having 'severe' trauma, which consisted of death resulting from injury or one of the following criteria:

- an Injury Severity Score (ISS) greater than 12
- a Prehospital Index greater than 3
- 4 or more injuries with Abbreviated Injury Scale scores (AIS) of 3 or greater
- a hospital stay greater than 3 days.

Patients who died 'at the scene' of the traumatic event were not included, but patients who died in the emergency department or who were dead on arrival at the hospital were included.

Phase I – initiation: Accreditation of trauma centres and initiation of a trauma care network (1993-1994).

In 1992, four hospitals were designated to become 'accredited' trauma centres – three in Montreal (Quebec Province's biggest city) and one in Quebec City (the provincial capital). This implies that the capabilities for care of the injured at these hospitals had to meet strict criteria established by the American College of Surgeons (ACS – a professional organization comprised of surgeons from Canada and the United States). In order to become accredited, the hospitals had to have a dedicated trauma team in the hospital at all times that included attending (i.e. fully trained) or senior resident staffing from general surgery, emergency medicine, anaesthesia, neurosurgery and orthopedic surgery. The centres also had to have an in-house emergency room with 24-hour availability. Additionally, operating theatre nurses had to be in-house at all times, while other doctor specialities had to be on call and available at the hospital within 30 minutes. The following year (1993), two of the hospitals in Montreal were accredited as level 1 (highest level, tertiary care) trauma centres.

The infrastructure of the designated trauma centres was strengthened through improvements funded by the Quebec government. Trauma treatment rooms were created in the emergency departments and fitted with the requisite equipment and diagnostic facilities. In addition to strengthening the physical infrastructure of the trauma centres, the Quebec government mandated an external review board responsible for reviewing the centre's compliance with, and maintenance of, ACS standards.

Phase II – intermediate: Creation of prehospital triage and inter-hospital transfer protocols (1995-1997).

Prehospital care was specifically addressed during this phase. At the start of phase II, no prehospital triage policy existed in Quebec. All patients were first taken to the nearest facility, at which point they were stabilized and then transferred to a higher level facility if necessary. Likewise, there was limited oversight or regulation of how care was delivered in the field by the different ambulance services involved. Several studies in Quebec had revealed problems with the system that needed to be addressed. First, it was found that if prehospital times were greater than 1 hour, the patient's risk of death tripled. Second, during 1993-1995, outcomes for patients who went directly to a level 1 trauma centre were compared with outcomes for patients who first went to the nearest facility and were then transferred to a higher level facility for definitive care. The study showed that people who were not taken directly to a level 1 trauma centre had a 57% higher chance of dying, and significantly longer intensive care unit and hospital stays.

Thus, prehospital triage guidelines were introduced, with the main aim of reducing prehospital times and identifying patients with life-threatening injuries who should be taken directly to level 1 trauma centres. These guidelines were introduced as informal, non-binding criteria during phase I and then officially mandated by provincial government in phase II.

These guidelines established the procedures to be carried out in the prehospital setting and those that should be avoided in the interest of speeding up hospital arrival. These guidelines also created triage protocols for emergency medical technicians (ambulance staff) based on injury severity and transport distance. These guidelines mandated that patients with severe injuries be taken directly to a level 1 trauma centre. If this was not possible (e.g. because of very long distances) and the patient had to be taken to a lower level facility, transfer to a level 1 trauma centre should be arranged as soon as possible. Transfer policies were established between the level 1 (tertiary), 2 (intermediate), and 3 (smallest, usually rural hospital) trauma centres to better determine who should be transferred to higher levels of care and to facilitate this transfer. Transfer agreements established between tertiary centres and surrounding hospitals were created to ensure compliance with these transfer protocols.

During this time, further progress was made on standardizing and upgrading the capabilities of the network of hospitals providing trauma care. In addition to the level 1 trauma centres created in 1993, level 2 centres were designated in 1994 and 1995, and level 3 centres were established from 1995 to 1996. In all cases, these were existing general hospitals that cared for injured patients, among others. The designation of a hospital as a trauma centre of a specific level did not imply the creation of a new hospital, but rather the upgrading of trauma care capabilities to specified, standardized levels. There are currently (in 2010) 26 level 3 centres, 27 level 2 centres and three level 1 centres. The level 1 centres are in the biggest cities – two in Montreal and one in Quebec City. The level 2 and 3 centres are distributed in approximate proportion to the population distribution in the province, with a higher concentration in the more densely populated south. There is at least one level 2 or 3 centre in each of Quebec's 17 regions, except for one region adjacent to Montreal which is close to the level 1 centre there. In addition, specialized centres were designated for management of specific types of injury, such as severe head and spinal injury.

Parallel to the creation of criteria for hospital capabilities in acute trauma care and inter-hospital transfer protocols was the development of criteria for longer term rehabilitative care. This included guidelines as to who should be sent to rehabilitation facilities after discharge from acute care hospitals. Likewise, criteria for what should be in place in rehabilitation facilities were established, as was an accreditation process for these facilities. Also addressed as part of the rehabilitation component of the trauma system were the needs of injured people with long-term disabilities once they are discharged home. Community maintenance services are provided by facilities and agencies for trauma patients with long-term disabilities who require support to stay in an optimal living environment. These services enable patients, relatives and those close to them to achieve an optimal quality of life and level of social participation.

Phase III – advanced: Review, evaluation, and consolidation of the system (1998 onward).

Once the fundamental components of the trauma system were established through trauma centre designation and the standardization of triage and transfer protocols, the system was expanded in a third phase. This phase sought to review, evaluate and consolidate the system's improvements and involved re-designation of trauma centres, including increased designation of level 2 and 3 centres to broaden the coverage of the trauma system. Several level 2 and 3 centres that did not meet the established criteria were de-designated and no longer participated in the care of trauma patients. There was also better integration of all hospitals with prehospital emergency medical services. The use of prehospital triage and scene management protocols became more completely established. The specialized centres for management of specific types of injuries (mentioned above) became operational during this phase.

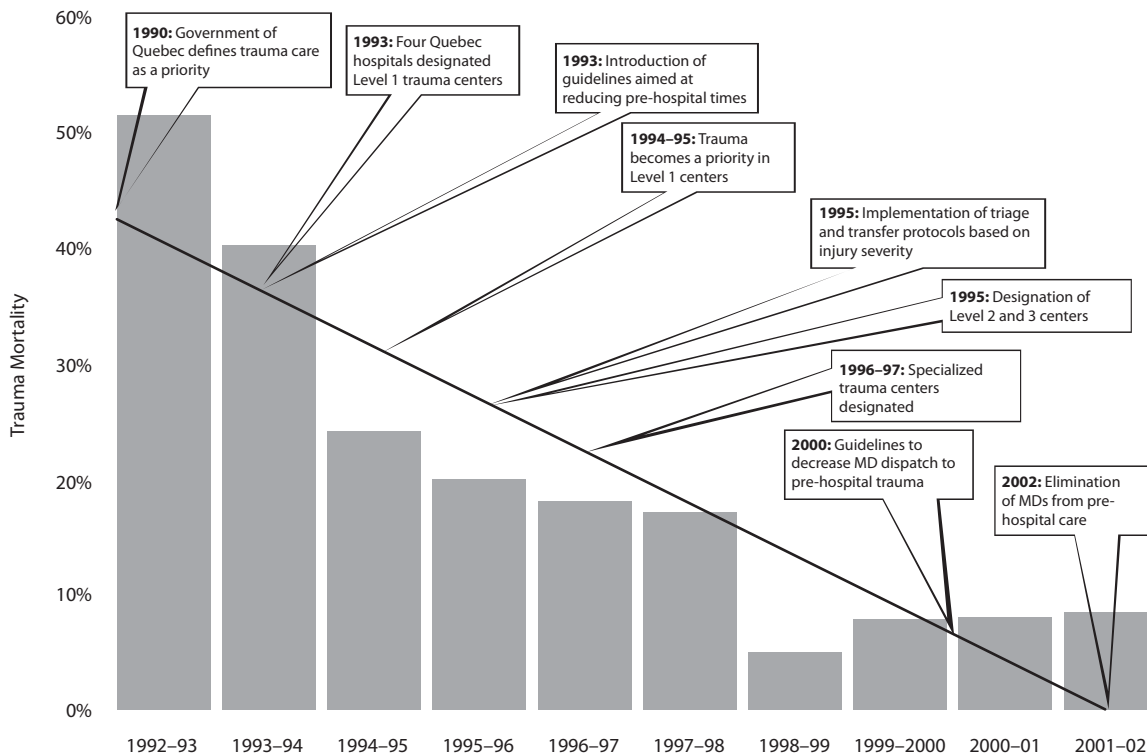
3. Results

The development of the Quebec trauma system was built on evidence, with policy changes being made in response to this evidence. This included evidence relating to the problems identified and evidence of the effectiveness of interventions. As an example of problem identification, studies had shown the damaging effect of prolonged scene times – this prompted the development of prehospital guidelines to eliminate unnecessary procedures and keep scene times short. As an example of establishing the effectiveness of interventions, the mortality rate for trauma patients admitted to the main three hospitals caring for injured patients in the province was shown to have decreased from 20% prior to their accreditation as level 1 trauma centres to 10% after. This significant improvement demonstrated the importance of the accreditation process and acted as evidence to lobby for expansion of the accreditation process.

Taken overall, these trauma system improvements led to sustainable improvements in the process of care. For example, the mean prehospital time decreased from 62 minutes before the initiation of the

system to 44 minutes in phase III. The proportion of patients with life-threatening but treatable injuries (Injury Severity Scores of 25 to 49) who were treated at a level 1 trauma centre rose from 36% before initiation of the system to 84% in phase III. These, and other similar changes, led to a steady decline in the mortality rate of severely injured patients, as shown in Figure 1. Mortality rates decreased from 52% prior to initiation of the system, to 8% from 1998 onward.

Figure 1 **Mortality among severely injured patients (by year) in Quebec**



Inclusion criteria specified death as a result of injury or an Injury Severity Score (ISS) exceeding 12, a Prehospital Index exceeding 3, two or more injuries with an Abbreviated Injury Scale score of 3 or higher, or a hospital stay exceeding 3 days. Note: small year-to-year fluctuations in percentage mortality are expected. The overall trend, however, is steadily downward. MDs = doctors.

Source: Liberman et al. Implementation of a trauma care system: evolution through evaluation. *Journal of Trauma*, 2004, 56:1330-1335 (with permission)

Similar analyses are underway to assess and monitor the effects of the parallel rehabilitation improvements. To assess these, measures of improved functional outcome need to be made periodically post-discharge, and hence a trauma registry based on discharge data from acute hospitals does not have the requisite data. Longer term follow-up studies are needed and are currently being undertaken as part of the ongoing evaluation of the rehabilitation component of the trauma system.

The overall costs for instituting and maintaining the Quebec trauma system were low and sustainable. There was an initial expenditure of Canadian \$ 2 000 000 (far less than 1% of the provincial health budget) for infrastructure expenditures to help get the major trauma centres up to designation criteria (as discussed in phase I above). The only ongoing cost is the administrative requirements for monitoring, evaluation and the regulatory oversight provided by the accreditation committee. These have been minimal as they relied heavily on volunteer work by academics and trauma care clinicians. Finally, the provincial

government instituted a system of reimbursing level I trauma centres with an additional amount for each severely injured person (Injury Severity Score of 16 or more) that they cared for, as these patients often consumed a greater share of hospital resources than is generally reimbursed by the health insurance system. The overall cost for this to the provincial government has been very low.

In summary, this case study demonstrates that even a well-resourced (e.g. high-income) environment can benefit from improving the organization and planning for trauma care services. This has also shown the benefits of system-wide planning, encompassing prehospital and hospital-based care in a large geographic area. The important role of monitoring and data also need to be emphasized. All steps taken were evidence based, whether in terms of problem identification, evaluation of pilot efforts or long-term monitoring of the entire system. Although the example is from a high-income country, the evidence-based, system-wide approach is applicable to all countries.

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Sri Lanka: The Trauma Secretariat

1. Introduction and statement of problem

Sri Lanka, an island with a population of 20 million, has a well-developed health-care system and its health status is widely acknowledged to be far better than expected for the country's lower-middle income status. For example, there are 274 primary health-care units, meaning no-one lives more than 4.8 km from one. However, rising rates of injury have been offsetting some of these benefits.

Since 1995, injuries have been one of the major causes of admission to government hospitals. In 2003, one in six admissions and one in nine deaths were the result of trauma. Road traffic crashes and injuries in the home represent a major fraction. In addition, a 30-year-long civil war contributed immensely to the burden of trauma.

Despite the well-developed health-care infrastructure, many problems have arisen in attempting to address the growing number of trauma patients. Until recently, there have been minimal capabilities for prehospital care, especially in rural areas. Injured people were usually cared for by bystanders and taken to hospital by whatever means available. In terms of hospital-based care, there were islands of excellence, but no standards that all hospitals caring for the injured had to meet. System-wide, there was no organized approach to monitoring of care and no reliable data to undertake such monitoring.

By the early 2000s, improvements had begun. An ambulance service was started in the capital city, Colombo, in collaboration between the Ministry of Health and the fire brigade of the municipal council. The main hospital upgraded its emergency department to include a well-equipped shock trauma room. Country-wide, the Primary Trauma Care (PTC) course was established. In addition to this, in 2005 the Sri Lankan Medical Association and the College of Surgeons of Sri Lanka (with the support of the WHO Country Office) organized a meeting to look at ways in which minimum standards for trauma care could be defined in hospitals nationwide, based on recently released WHO publications – *Guidelines for essential*



Trishaws are a common means of transporting trauma casualties to hospital

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trauma care (WHO, 2004) and *Prehospital trauma care systems* (WHO, 2005). This effort had a special focus on mass-casualty management, the importance of which had been demonstrated during the tsunami tragedy. Thus, movement was indeed occurring, and these improvements were considerably catalyzed by the creation of a Trauma Secretariat.

2. Improvements implemented

The initial focus for system-wide improvements was the trauma component of a project called Evidence-Based Medicine for the Development of Health Care – a nationwide endeavour to strengthen the entire health-care system. Government invited stakeholders as ‘key personnel’ in the initial planning phase. This included professional bodies such as the College of Surgeons of Sri Lanka, the College of Anaesthesiologists, and the Sri Lankan Medical Association. There were several policy meetings which eventually led to the creation of the Trauma System Development Committee (TSDC), which eventually became the technical advisory arm of the overall Trauma Secretariat. A comprehensive trauma system that addressed the entire spectrum was considered, from prevention through prehospital care to hospital care and rehabilitation. Five subcommittees were formed:

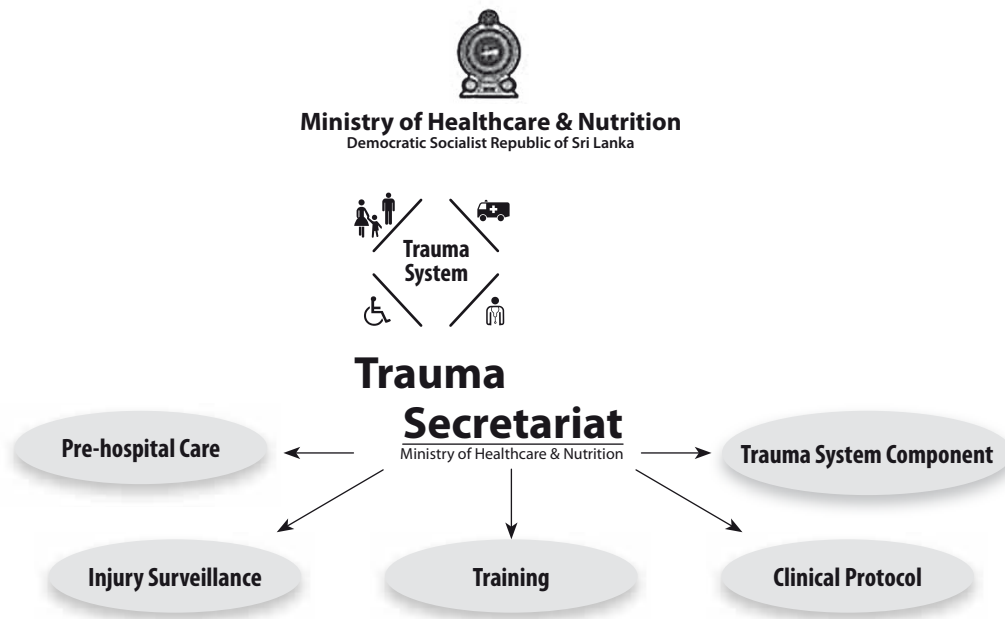
- prehospital
- injury surveillance
- training
- clinical protocols and guidelines
- policy and system development

Further details of the goal for each subcommittee are shown in Table 1.

TABLE 1 **Trauma System Development Committee components**

<p>1. Pre-Hospital Care Sub-committee Objectives: • To reduce morbidity and mortality of the injured Activities: • Creating a ‘forum’ for stakeholders • Supporting Colombo EMS and helping several municipalities to set up EMS • Development of curriculum for EMT training • Development of emergency ambulance regulations - Promotion of legislation</p>
<p>2. Injury Surveillance Sub-committee Objectives: • Establish a registry • Use evidence Activities: • Advocacy for injury surveillance • Surveillance tools developed: Data set, manual, entry software, compilation software • Piloted in four hospitals • Expanded to continuous data collection in six hospitals</p>
<p>3. Training Sub-committee Objectives: • Develop a national training programme for all categories of staff dealing with trauma Activities: • Conducting Primary Trauma Care (PTC) programme • Working towards expansion of nurses training programme on mass casualty & trauma care • Establishing and conducting National Trauma Management Course (NTMC) for senior doctors</p>
<p>4. Clinical Protocols and Guidelines Sub-committee Priorities: • Review existing resources • ‘Sri Lanka Trauma Guidelines’ developed</p>
<p>5. Trauma System Components Sub-committee Objectives: • To develop a national trauma system integrated with all components of injury spectrum Activities: • Sri Lanka trauma centre designation criteria developed</p>

Source: www.traumaseclanka.gov.lk, with permission of Trauma Secretariat of Sri Lanka

Figure 1 **Functions of the Trauma Secretariat**

Source: www.traumaseclanka.gov.lk, with permission of Trauma Secretariat of Sri Lanka

After initial background research and preparatory work by each of these subcommittees, the Ministry of Health initiated the development of the trauma system in 2006 and the Trauma Secretariat was officially launched in 2007 (Figure 1). Its vision is the 'Provision of timely, appropriate, quality and cost-effective medical care to trauma victims by a coordinated and sustainable trauma system with improved preparedness.'

Since its creation, the Trauma Secretariat has engaged in many activities in each of the main trauma system categories.

Prehospital care: As noted above, just prior to the creation of the Trauma Secretariat, a fire brigade-based emergency medical service (EMS) was created in Colombo. The Trauma Secretariat was able to help this EMS develop by attracting funding for it and carrying out training for 30 newly recruited firemen who staffed the ambulances. Initially this service was exclusively for trauma victims, but recently it has been expanded to include all types of emergencies. In addition to the technical work of establishing and expanding the ambulance service, the secretariat has carried out public information campaigns to make the public aware of the service and to increase appropriate use of it.

There were also several nationwide developments. A single, nationwide number has been allocated for use in an emergency. Criteria for the qualifications of Emergency Medical Technicians (EMTs) have been defined. Standards for training first responders have been developed, and training of lay people as first responders has been carried out nationwide. This has included training people most likely to come into contact with the injured, including traffic police and trishaw drivers. Likewise, funding and technical assistance have been procured to initiate or improve fire brigade ambulance services in towns throughout the country.

Injury surveillance: Efforts to improve injury data for decision-making have included a pilot project in four hospitals. This ran for 15 months (2006-7) and yielded data on 20 000 patients. This has been expanded into a National Injury Sentinel Surveillance System, which includes a total of six hospitals, distributed nationwide. Based on this pilot project, an instruction manual for injury surveillance, a standardized form (the Trauma Surveillance Record), and corresponding software were developed. These tools made use of

the considerable lessons learned during the pilot phase and staff at five of the six hospitals have now been trained in their use.

Training: As noted above, the PTC course had been running since 2003 and the secretariat helped this training roll-out island-wide. So far, nearly 2000 medical officers have taken the PTC. In addition to this basic course, more advanced training has been carried out, including the Advanced Trauma Resuscitation and Initial Management course for Surgeons (ATRIMS) developed by the College of Surgeons of Sri Lanka. Similarly, the National Trauma Management Course (NTMC) of the International Association for Trauma Surgery and Intensive Care (IATSIC) has recently started to run, with training of trainers courses conducted. The secretariat is also in the process of designing a trauma course specifically for nurses.



Injury surveillance training
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Guidelines and protocols: Clinical guidelines for trauma care management in a variety of settings have been published, including easy-to-follow diagrams. This has been translated to Sinhalese and Tamil. Draft copies have been distributed among selected medical personnel for critique. Once the necessary changes are made it will be available for the target audience: medical officers at emergency treatment units (ETU), accident services and outpatient departments.

Policy and system development – trauma centre designation: Following intense discussion, a matrix for trauma centre designation has been completed. Four levels of hospitals providing trauma care have been defined, and minimum requirements for capabilities have been established. This document has been reviewed by independent observers from the professional colleges and been sent to the Ministry of Health for approval. When approved, this will upgrade and standardize trauma care capabilities in Sri Lanka's hospitals.

A much felt need – disaster management: After the tsunami in 2004 the government took every possible step to improve the approach and prepare for future disasters. A new, separate Ministry of Disaster Management was established for this purpose. Alongside this, the Ministry of Health established a Disaster Management Unit to initiate work on medical response to disasters. Although a separate unit, its work is closely linked with the Trauma Secretariat. Already there have been two consultative workshops, and progress has been made towards establishing a national plan.

3. Results

As shown in the case study from Quebec, Canada, system-wide improvements in trauma care can take a long time to institute and an even longer time to bear fruit. Nonetheless, within the few years that the Sri Lanka Trauma Secretariat has been in existence it has been able to put in place many of the same broad organizational structures and changes implemented in the early days of the Quebec provincial trauma care system. The existence of the Trauma Secretariat has allowed some system-wide and systematic improvements in trauma care nationwide that would not otherwise have been possible, such as the following:

- Funding from multiple sources can now be coordinated for a more coherent overall effort. What were disjointed, disparate activities in the past now have more commonness of purpose (i.e. the whole is greater than sum of its parts). Also, having a well-organized and respected organization such as the Trauma Secretariat has allowed greater sums of funds to be raised than would smaller, scattered groups attempting to do the same work.

- The Trauma Secretariat is invested with authority from the government to create nationwide recommendations and standards, such as those on trauma centre designation, training criteria and clinical protocols. The Trauma Secretariat enables these efforts to draw in a greater amount of expertise than if they were done by separate groups. Likewise, the Trauma Secretariat's broad consultative process generates recommendations that are respected and credible, and more likely to be acted upon than if they had been created by individuals or even larger groups such as professional societies.
- The creation of the National Sentinel Injury Surveillance System is one of the major achievements of the Trauma Secretariat. It is unlikely that it could have been done by any other unit.
- Educational activities such as the various courses mentioned above (e.g. PTC, NTMC and ATRIMS) are now run much more regularly and are more widely distributed across the country. The oversight provided by the Trauma Secretariat has allowed better coordination of the courses and enabled them to reach previously underserved areas of the country.

Thus, the Trauma Secretariat has added considerable value to the efforts of many smaller groups that were previously working in isolation. All the above work of the Trauma Secretariat has required resources. Some financial and technical support has been provided by outside groups, including JICA (Japan International Cooperation Agency), the Netherlands Government, the WHO Country Office and NGOs including AmeriCares and Medical Team International. However, it is important to stress that most of the work has been done using local resources, local skills and staff time, much of it volunteered. This includes the work of running the committees and carrying out programmes, including numerous training courses.

Summary and lessons learned

The case studies in this book provide important lessons learned for future efforts to improve care of the injured. Many of these lessons are common to most or all of the case studies. They apply to efforts to improve services, whether in the prehospital setting, in acute care facilities (both in emergency departments and in the hospital more widely), in facilities that provide rehabilitation services, or system-wide. They likewise apply across the economic spectrum in low-, middle-, and high-income countries. They fall into several broad categories: overarching issues, tools to use in promoting improvements, and policy and advocacy.

Overarching issues

Perseverance

The changes did not happen overnight. In some cases, such as those from Brazil, Canada and Thailand, changes took a decade or more to implement. There were many ups and downs and frustrations along the way. The improvements were accomplished by people working in the system who were willing to endure these frustrations and short-term failures in order to make gradual but steady progress.

Attention to detail

There was no magic bullet for any of these improvements. They occurred by painstaking attention to detail in planning and execution. Almost all of the case studies demonstrate the importance of better organization and planning. For example, the achievements of the quality improvement programme in Thailand and the trauma service in Qatar primarily revolved around improved delivery of existing services by better organization and monitoring.

Economic spectrum

Improvements can be made even in the poorest and most difficult of circumstances, such as post-conflict, mine-ridden areas of Cambodia and Iraq. Even well-resourced environments can benefit from improved organization and monitoring of trauma care services, whether on an institutional level (as in Qatar) or system-wide (as in Canada).

Tools to use in promoting improvements

Training

One of the main tools used was training. This involved methods ranging from short 1-2 day courses to promoting full certification. The improvements in Cambodia, Iraq and Mexico primarily emphasized training. Similarly, training played a key role in the work of the Trauma Secretariat in Sri Lanka and the trauma service at the main hospital in Qatar. However, in almost all cases, the training was not haphazard and isolated, but rather was structured and conducted in an environment where the skills learned in training were then reinforced by supervision and monitoring.

Combined approach

Improvements in infrastructure, equipment, communications and training are most effective when instituted together, as demonstrated by the broad-based emergency medical services (EMS) improvements in Mexico.

Emphasize the basics

In almost all of the case studies, it was basic and affordable improvements that made the most difference. In Mexico, ensuring wider availability of basic life-support capacities made more of a difference in trauma mortality than more costly investments in advanced capabilities. Similarly, in Cambodia and Iraq, wide dissemination of training in basic life-saving skills and capabilities (even by village volunteers) was the key element for success, and more advanced capabilities were rarely used. The rehabilitation measures promoted in hospital in Brazil, and in hospital and community in India were likewise eminently affordable and sustainable.

Team work

Many of the improvements involved creating or enhancing existing on-the-ground teams to get the clinical work done in a better-organized and more effective way, such as trauma teams that were the basis of the trauma service in Qatar and the simplified rehabilitation team that was the basis of the innovative and affordable response to the lack of rehabilitation services in Brazil.

Trauma care as part of broader efforts to strengthen health systems

In some cases, improvements were primarily focused on care of the injured, such as in Qatar and Viet Nam. Other cases represented broad-based improvements in the health-care system that were of great importance to improving trauma care, such as the creation of the National Ambulance Service in Ghana or EMS legislation in Colombia and Romania. In other cases, efforts that were primarily directed at one specific subset of trauma patients eventually led to broader efforts that included other types of injured people and medical problems. For example, the prehospital capabilities in Cambodia and Iraq initially focused on victims of landmine blasts. As the system grew, it encompassed motor vehicle crash casualties and more general medical emergencies. Similarly, the rehabilitation programme in India initially focused on people with spinal cord injuries after the Gujarat earthquake. As the programme developed, it integrated people with disabilities regardless of the nature and cause. In virtually all efforts to strengthen care of the injured, it is important to look for synergies with other parts of the health-care system.

Need for accurate and timely data

Data are necessary to convince policy-makers of the extent of the toll of injury and the need for improvements. Data are also vital to ensure that improvements enacted are evidence-based, and thus more likely to be effective. Data are likewise important for ongoing monitoring and evaluation. This is needed in order to know which interventions have been useful and are thus worth continuing or expanding, and which interventions are not effective and thus should be changed or abandoned, with resources shifted to more effective uses.

Establishment of trauma registries to provide such data were integral parts of the trauma system efforts in Canada and Sri Lanka. More basic efforts to improve record keeping can be equally vital and were key to the improvements in Mexico.

Policy and advocacy

Political commitment

Improvements can occur through the hard work of individuals. However, these improvements will certainly be helped by political commitment. Getting improvements institutionalized or made permanent, and getting them scaled-up more widely, almost always requires political commitment. This political commitment can come at one or more levels, ranging from national to institutional. National-level political commitment was needed for the creation of the nationwide Trauma Secretariat in Sri Lanka. The trauma system in Quebec, Canada, required the designation of trauma as a priority health problem by the provincial government. The systematic improvements in trauma care capabilities in Viet Nam came about as a result of a directive from the Hanoi Health Department. The work of the Trauma Audit Committee at Khon Kaen, Thailand, was possible only because the committee was empowered by the hospital administration to make the necessary changes.

Promoting policy

There are centres of excellence in many countries. These can help improve care of the injured more broadly in their countries by setting a precedent for others to match. However, often this may not be enough. Nationwide legislation (or state/province-wide in federal systems) can be an important avenue for promoting widespread, nationwide improvements, by establishing and enforcing standards. As shown in Colombia and Romania, this is an important way to reach institutions and areas that are under-performing and would not otherwise meet minimum standards on their own. Development of nationwide legislation can be promoted by professional groups, who can develop suggested standards for government to consider adopting, serve as experts for government to call on in developing technical aspects of the legislation, and can advocate for adoption of such legislation. The Trauma Secretariat in Sri Lanka and the Colombian Prehospital Care Association have both played this leadership role in guiding the improvements in trauma care in their countries.

Creation of a key government position to implement policy

Legislation and policy are certainly useful. They are even more useful if there is a designated, interested and empowered government official assigned to implement the legislation, as is the case with the position of Under-Secretary of State for Emergency and Disaster Medicine in Romania.

Advocacy

Advocacy is key in generating the political will discussed above. This advocacy also involves the need for patience and perseverance, promoting the same message of affordable and sustainable basic improvements, often repeated to successive administrations. During this often prolonged period, advocates need to be watchful for the opening of policy windows, when factors align to allow changes. Being ready to take advantage of policy windows is key. For example, the tragedy of the mass-casualty event at the sports stadium in Ghana led to a policy window that eventually allowed creation of the National Ambulance Service.

Community involvement

The community, whether as individuals or as organized civil society, are key to advocacy. They can also be active participants and key members of many of the trauma care interventions, as was the case with the village volunteers in Cambodia and Iraq, and the community development workers in India.

Leadership and partnerships

Many improvements instituted in these case studies came about because committed leaders, usually leaders working directly in the field, pushed for them and persevered despite initial difficulties and setbacks. For example, the improvements in the EMS in Mexico, the improved capabilities for facility-based trauma care in Viet Nam, and the improved rehabilitation capabilities in Brazil all directly resulted from on-the-ground clinicians leading efforts to improve the scenario in which they directly worked. Such leadership is even more effectively applied when it is extended with partnerships. The Colombian Prehospital Care Association, which was instrumental in promoting nationwide legislation on prehospital care, is an excellent example of such a partnership of stakeholders from many different backgrounds. Likewise, the sustainability of the rehabilitation work in India was enhanced by community-level partnerships involving health-care workers, non-governmental organizations, disabled people's organizations and civil society.



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ISBN 978 92 4 1563963



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